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STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
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DECEMBER, 1941

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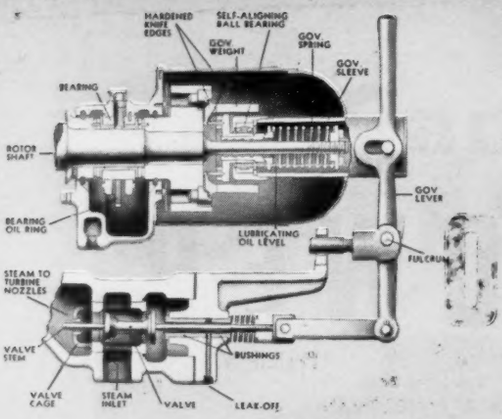

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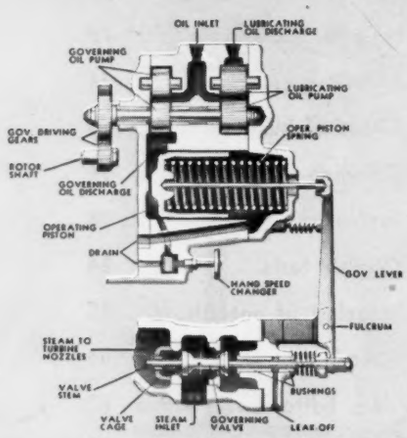

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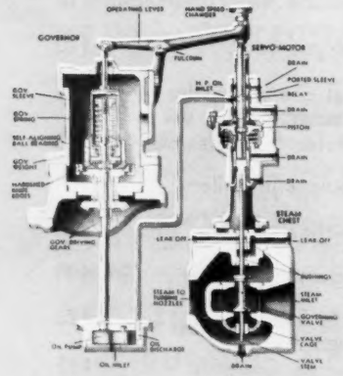

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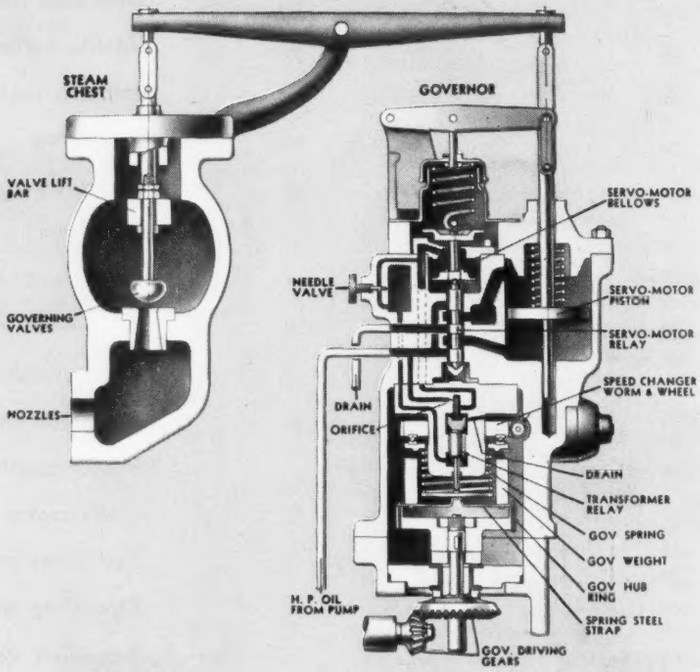


CENTRIFUGAL - WEIGHT, TRANSFORMER TYPE GOVERNOR. Has extra sensitivity and close speed regulation for multiple automatic valve turbines. Operates on same principle used in governors for largest Westinghouse turbines. Normal speed regulation, 0 to full load, is 4%. Maximum speed adjustment while turbine is running is 20%. Provides quality of regulation required for generator drive. A modification of this governor is available for speed adjustment up to 25-to-1.

*

By the addition of a pressure control device, any of the above governors may be made pressure-responsive. Westinghouse has a full line of accessories for special control requirements, including: hand speed changers, electric speed changers for remote adjustment of turbine speed, and solenoid control for remotely shutting down turbines.

Westinghouse

HANDBOOK of FEEDWATER TREATMENT

TODAY, no boiler operator needs to be sold the idea that it costs less to treat boiler water chemically and mechanically than to suffer the consequence of scale, corrosion, carryover and embrittlement. No designer of plants, big or little, overlooks the potential shutdowns that can interrupt the desired long steaming periods.

But the art and science of boiler-water conditioning has progressed beyond the average operator's offhand knowledge of available chemicals and equipment. Water-treatment engineers, working with the highly specialized tools of chemical engineering and organic chemistry, have taken the feedwater problem out of the "patent medicine" and "secret formula" class. In the pages of the technical press, the transactions of engineering societies and the bulletins of equipment manufacturers lies a liberal education in boiler-water conditioning.

Unfortunately for the plant operator, and for anyone else not versed in water chemistry, the language is often that of the laboratory. Each technical paper tends to overlook the simple fundamentals because of a primary interest in a specific and complex problem. The combination results in a situation comparable with that of an ordinary human reading the medical journals in search of a specific treatment for measles.

POWER cannot expect to cram within 32 pages a complete education in so complex a subject. Our job becomes one of sifting a maze of technical data, some of it more recent than the textbooks, and presenting the basic ideas in the language of the engineer. In this we have had the wholehearted support and practical help of leading water-treatment engineers and manufacturers. Their research and practical developments have created the modern era in water conditioning and they have freely assisted our effort to interpret this important field for POWER readers.

This "handbook" of feedwater treatment falls into two divisions. The first presents a non-chemical and practical statement of problems, methods and practice. The second supplies the basic chemistry needed for a fuller understanding, boiled down and simplified for the plant operator and design engineer.

All water conditioning can be viewed as preventive medicine, something you do and pay for to avoid costly and unpleasant consequences. This primer of simple physical and chemical facts about water will scarcely enable an operator to prescribe a complete treatment for boiler ills. It will accomplish its purpose if it enables the man responsible for boiler health to distinguish between a common headache that can be relieved with an aspirin and the perhaps less painful but deep-seated roots of cancer that call for all the skill of a trained doctor.

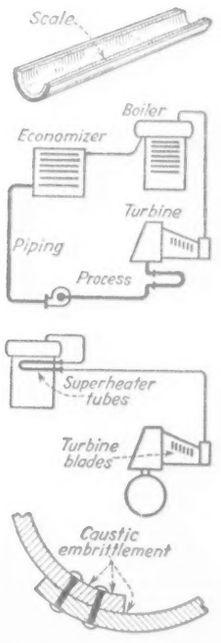
An understanding of water-treatment principles starts with a clear grasp of its objectives. These are everywhere the same, whether the boiler is large or small, high-pressure or heating-steam. They are fourfold:

1 SCALE PREVENTION requires reducing to low limits the hardness factors, calcium and magnesium, so that they will not produce hard deposits on boiler heating surfaces and cause overheating of boiler metal

2 CORROSION PROTECTION for metal in boilers, economizers and piping requires maintenance of a satisfactorily high pH value and elimination of oxygen, carbon-dioxide and other corrosive gas dissolved in water

3 CARRYOVER ELIMINATION, to avoid deposits in superheater tubes and on turbine blades, requires maintenance of low dissolved solids, alkalinities and sludge concentrations.

4 EMBRITTLEMENT INHIBITION, to avoid cracks between crystals of drum metal, requires maintenance of proper balance between sulphates and carbonates in the drum water, as recommended by the ASME Boiler Construction Code



POWER · DECEMBER, 1941 · P W SWAIN, EDITOR

OBJECTIVES

SCALE, CORROSION, CARRYOVER,

■ PREVENTION OF SCALE is the most common reason for undertaking any water-treating program. Presence of hard scale on heating surfaces reduces heat transfer to the boiler water. Contrary to common belief, this reduced heat-flow rate has only a minor effect on boiler efficiency because the temperature difference between boiler water and flue gas is relatively great. Even a ⅛-in. layer of scale on the water side represents only a small percentage increase in total resistance to heat flow. In addition, hotter gas passes to the remaining boiler banks, and economizer and air preheater, increasing their heat absorption. The scale, however, insulates the metal from the cooling effect of the boiler water and tube failure may eventually result. Scale, if allowed to form, must be removed mechanically, involving maintenance expense and boiler outage.

Scale results from the chemical effect of heat on the dissolved hardness of natural waters. Water containing this dissolved hardness flows into the drum continuously, and because the steam removed from the drum is practically pure, the concentration of dissolved solids in the drum increases. This accelerates scale-forming tendencies. Chemically, scale consists of insoluble compounds of calcium and magnesium, in most cases. Often it is cemented into a hard mass by silica.

Scale formation is avoided by (1) removing or reducing calcium, magnesium or silica before the feedwater reaches the boiler (pretreatment), (2) adding chemicals in the boiler drum to cause the solids to form sludge instead of scale (internal treatment), and (3) removing dissolved solids and sludge from the boiler (blowdown).

At high pressure the scale problem presents added difficulties. Boiler-water temperature is higher and this affects the rapidity of chemical reactions. It also causes dissociation of sodium carbonate into caustic soda and carbon-dioxide and thus increases tendency to deposit scale. Thus sodium carbonate (soda ash) offers some protection against scale formation in boilers operating at 200 lb or less, but other chemicals, such as one of the sodium phosphates, are more suitable for pressures from 400 lb up.

High pressure, with attendant high boiler-water temperature, also brings high boiler-tube temperature. With tube metal closer to its softening point, scale can more quickly cause bagging, blistering, or eventual failure. To some extent, water conditioning depends on boiler design in that adequate circulation usually means cooler tube metal. Tubes that go dry because of inadequate circulation burn out as readily as those overheated from scale formation.

Other plant operating conditions, aside from pressure, affect the scale problem. Among these are: (1) the ratio of makeup to condensate, (2) the boiler operating schedule, and (3) condenser leakage. Boilers in large central stations, even though operated at high pressure, require little makeup and thus need little protection against scale. With high makeup percentage, elaborate pretreatment with supplementary internal treatment may be justified. Likewise, more costly equipment and chemicals may pay where boilers must steam at high rates for long periods and loss in production or need for spare capacity makes boiler outage expensive. Condenser leakage, particularly if the circulating water is salt, adds chlorides to the boiler water and, if nothing else, increases the amount of blowdown.

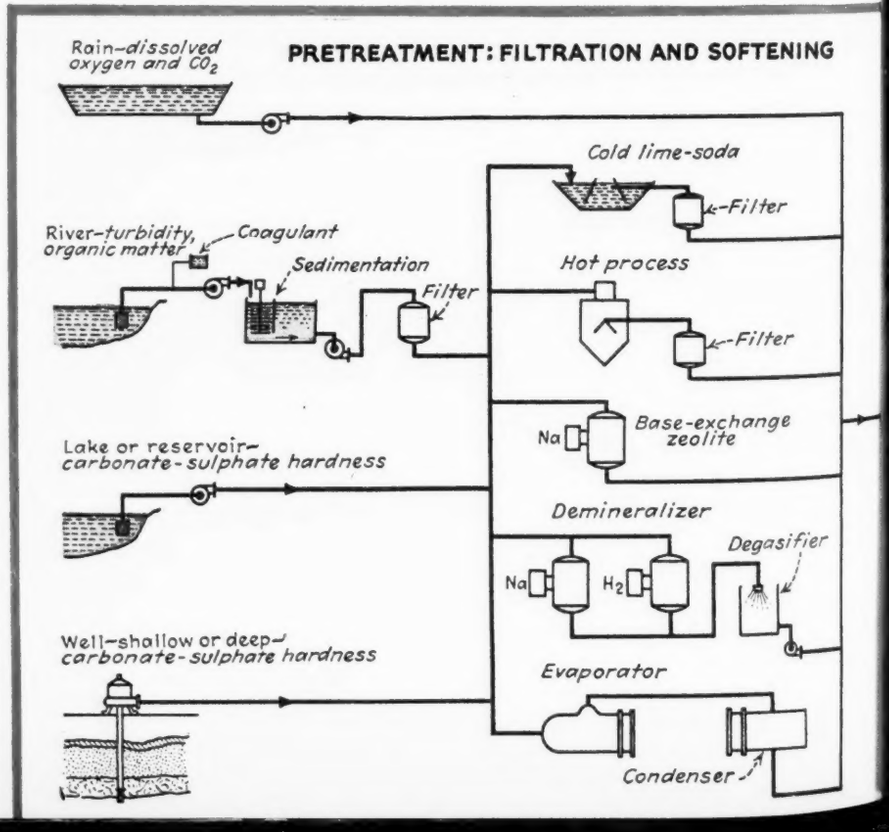
Corrosion

Boilers, economizers, feedwater heaters and piping, usually made of iron and steel, must be protected against rusting or pitting. Corrosion of iron results from: (1) relative acidity of water, and (2) presence of dissolved oxygen, carbon dioxide, ammonia or other gas. The prescribed remedies are: (1) neutralizing water acidity with an alkali, (2) removing dissolved oxygen in a deaerator, and (3) neutralizing remaining traces of oxygen by a deoxidizing agent or oxygen scavenger.

Acidity of water is now measured in terms of hydrogen-ion (acid) concentration, the now familiar pH. Without going too deeply into the chemical meaning of the ionic relationships, it should be understood that pH 7.0 is the neutral point, neither acid or alkaline. Values less than 7.0 are acid, values above are alkaline.

Carryover

Chemicals added to boiler water as softening agents, as well as residual amounts of natural impurities, increase the tendency to foam within the boiler drum much as bubbles can be blown from a soap solution. Foam formed at the water level in a boiler drum is carried over with the steam. Apart from the purely mechanical troubles with engines and turbines caused by slugs of moisture, foaming causes carryover of dissolved solids that deposit in superheater tubes and on turbine blades.



EMBRITTLEMENT

Superheater deposits cause tube burnouts, and turbine-blade deposits tend to reduce the size of steam passages and consequently the maximum load the turbine can carry.

Steam washers prove effective in controlling the amount of carryover within reasonable and tolerable limits. Reducing concentration of dissolved and suspended solids in the boiler drum by blowdown minimizes foaming. Size of boiler drum, operating pressure and proportion of sticky suspended matter determine the allowable solids concentration in the drum. Some high-pressure boilers cannot be operated satisfactorily at drum concentrations above 300 ppm, while generously proportioned low-pressure units can tolerate 2000-3000 ppm. In some cases, maintaining a relatively high ratio of sulphate to hydroxide has been found to prevent adherent deposits on turbine blades. Oil-contaminated condensate greatly increases foaming and the only answer seems to lie in keeping oil out of boilers by coagulation and filtration.

Caustic Embrittlement

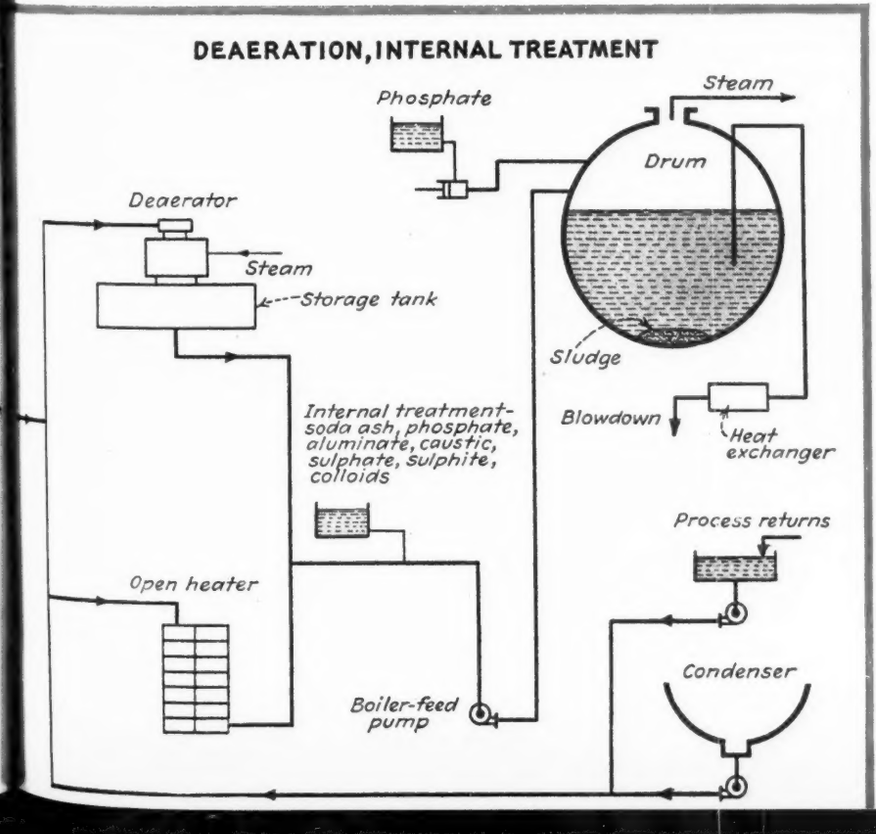
The tendency of caustic (sodium hydroxide) to concentrate in drum seams, under rivets, or at rolled tube joints has caused chemical failure of boiler-drum metal. Cracks form in a region of high stress when strong caustic concentrations exist. It is believed that silica acts as an accelerator.

It takes a combination of five factors to cause embrittlement (selective intergranular corrosion). These are: (1) presence of sodium hydroxide, (2) presence of silica, (3) local concentration, by evaporation or other cause, to produce strong caustic, (4) a local region of high stress, and (5) concentrated caustic in contact with boiler metal. Since most of these can be present in any boiler at some time or another, maintenance of the socalled ASME ratio of sulphate to total alkalinity (as carbonate) is still recommended as insurance against embrittling tendencies in boilers operating at 400 lb or less. The ASME Code calls for a one-to-one ratio between sulphate and carbonate for pressures below 150 lb, two-to-one for pressures between 150 lb and 250 lb, and three-to-one above 250 lb.

High-pressure boilers normally have to operate with low solids concentration in the drum water, making maintenance of a three-to-one ratio costly in blowdown.

While methods for determining embrittling tendency in the laboratory are relatively new, at least one laboratory is now making such tests as a routine procedure. There has also been developed an embrittlement detector for installation directly on the boiler.

Where conditions favor embrittlement, treatments with organic materials, such as tannins and lignins, have been tried successfully. Other methods include addition of sodium nitrate and use of phosphate instead of caustic for maintaining alkalinity.



WATER

■ If water were H_2O and nothing else, or if all waters contained the same impurities, water treatment could be reduced to a nearly uniform prescription. However, pure water never occurs in nature. The nearest approach is rainwater, and even that contains dissolved oxygen and carbon dioxide picked up from the air; with these it is definitely corrosive.

Impurities in natural waters depend largely on the source. Accordingly waters are classed as "ground water" (shallow and deep wells, springs) and "surface water" (rivers, lakes, reservoirs). Ground water almost always picks up dissolved hardness as it seeps through rock strata containing lime and magnesia but is usually clear and free from suspended matter. Dissolved solids include calcium, magnesium, silica, alumina, and sodium. Hardest waters are found between the Alleghenies and the Rockies.

Moving surface waters (rivers) contain organic matter such as leaf mold and trash and often carry along insoluble suspended matter such as sand and silt. They are frequently polluted by industrial and sewage wastes. Characteristics change rapidly, depending on rainfall, stream velocity, and the like. Still surface waters (lakes, ponds, reservoirs) settle out the suspended solids and are the best of natural waters.

In general, surface waters require "clarification" by filtering out suspended solids. They may also require "softening" (removal of dissolved solids), if part of the supply comes from underground springs. Ground waters need softening but rarely clarification, because the natural filtering effect of passage through rock or sand removes any organic or insoluble solids.

Ground-water hardness usually consists of calcium and magnesium bicarbonate, called carbonate hardness because it is easily convertible to the carbonate. Municipal water supplies are not usually softened because sedimentation and filtration are sufficient to render water potable, that is, satisfactory for drinking and domestic purposes. Because the objectives of boiler-water conditioning are entirely different, it is usually necessary to undertake some form of further treatment even when water from a municipal supply is used.

Illustrated on this page are common methods of water treatment specifically adapted to water for power plants.

SEDIMENTATION, COAGULATION, FILTRATION,

A COMBINATION of several treatments may be required to obtain boiler water with satisfactory characteristics. These operations may be accomplished step by step, or two or three objectives may be achieved with a single piece of equipment. The principles of sedimentation, coagulation, filtering and softening are much the same, whether they are arranged in series or carried out in a single tank; explanation is simpler if each is discussed separately.

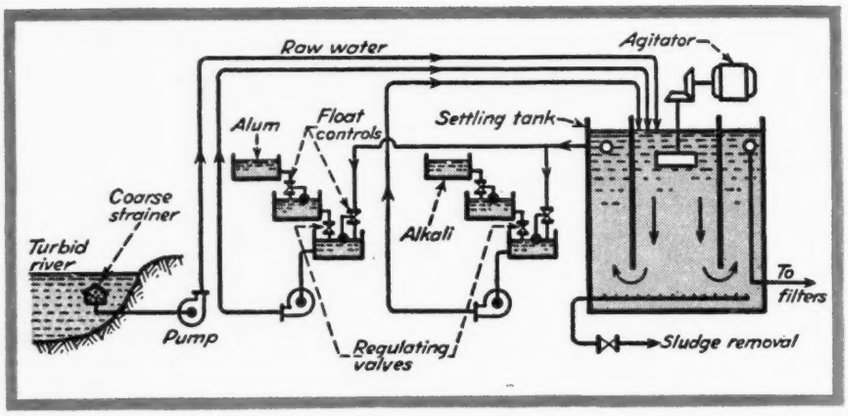


Fig. 1—Steel sedimentation tank with alum feed for coagulation and alkali feed for pH control. Such tanks are usually applied to removing suspended matter from river water

Sedimentation

If stilled in a pool, suspended material such as silt, leaf mold and slime will tend to settle out, leaving clear colorless water. Makeup taken from a lake, for example, has little suspended-solid content, while that from a river may at times contain large quantities of undissolved solids, a condition referred to as high turbidity.

Municipal water supplies, involving large quantities, are partly clarified by stilling in large concrete settling basins. However, boiler feedwater, in relatively smaller quantities, is more often clarified in steel sedimentation tanks with the chemical help of a coagulant.

Coagulation

Settling of suspended matter can be greatly hastened by any of several salts of aluminum or iron. These include alum (aluminum sulphate), sodium aluminate, ferrous sulphate, ferric chloride and, more recently, hydrated iron oxide and ferric sulphate.

Coagulants produce jelly-like snowflakes (floc) that bind together microscopic particles of silt, organic matter and even bacteria. The formation of the floc is a chemical reaction, but the gathering in (adsorption) of solid particles is mechanical, like catching flies on sticky flypaper. Only suspended solids are affected, hardness or dissolved oxygen are not removed.

Alum and ferrous sulphate (copperas) are slightly acid and require some natural alkalinity in the water for the chemical reaction which forms the floc. If sufficient alkalinity is not present in the form of bicarbonate hardness, lime, soda ash or caustic soda must be added. With only bicarbonate hardness present, alum floc forms best at pH between 5.7 and 6.6. If sulphates predominate, pH should be down to 5.5, but if chlorides are the principal impurity, best flocculation is at pH 8.0.

The amount of alum required ranges from 0.1 to 0.7 lb per thousand gal of water treated. Usually 0.1 lb is sufficient. Where alkalinity has to be increased, the amount of soda ash or lime is generally about one-half the amount of alum. The reaction produces CO_2 in the water.

Ferric hydroxide and ferric sulphate coagulate best at pH 7.7. Ferrous sulphate requires even higher pH and its reaction needs dissolved oxygen in the water to produce the floc.

Sodium aluminate is slightly alkaline, requires no lime or soda-ash treatment and produces a voluminous floc by reacting with magnesium hardness in the water. If silica is present in suitable form, a complicated silicate results which not only serves as a good floc but aids in keeping the silica out of the boiler circuit.

After the coagulant is introduced, the floc is allowed to form and settle in wood or steel tanks similar to Fig. 1. Water and chemicals enter a center compartment containing mixing paddles. Sludge and mud are carried to the bottom and removed through a pipe-lateral system controlled by a quick-opening valve; this is a periodic operation.

Filtration

Sedimentation and coagulation are essentially filtering processes in that they remove up to 90% of the suspended solids from turbid waters. If the water then requires some external softening, further precipitates will be formed. Filters located after the softener remove these just before the water enters the feed cycle. If lake or well water requires no preliminary sedimentation, and if internal boiler-water treatment is sufficient, filters may be the only pretreatment required.

Water enters the top, Fig. 2, flows downward through layers of graded sand, calcite, magnetite, anthracite, or other filter material. Silica sand, most common filter material, is partly dissolved by alkaline waters; filter beds that follow lime-soda softeners should be of non-silicious material. Clarified water leaves the filter shell through an underdrain system of slotted or perforated strainers. Being completely enclosed, the filter can be included in the piping system without a separate pump.

Filters should remove particles of suspended material smaller than the interstices between particles of sand. This is accomplished by forming a floc on top of the sand layers. If a coagulant has already been added as part of a sedimentation process, enough will carry over to form the floc, otherwise alum is introduced in the raw water just ahead of the filter.

Pressure filters usually operate at flow rates from 2 to 3 gpm per sq ft of filter-bed area. The shell itself can be either horizontal or vertical but the flow is always downward. As operation continues, dirt and floc accumulate in the upper part of the filter bed, penetrating deeper as the spaces between sand grains fill up. As the bed becomes

SILICA REMOVAL

more tightly packed, pressure loss across the filter increases. Continued operation then causes cracking and channeling of the filter bed and loss of filtering efficiency.

Manufacturers recommend that filters be backwashed when pressure loss reaches 5 lb and provide pressure gages on inlet and outlet piping for determining how long each filter should remain in service. Interval between washings may range from 4 to 24 hr, depending on the water's turbidity and the flow rate through the filter bed.

Backwashing is simply a reversal of water flow through the filter bed at a rate five times or more of normal downflow. Upward flow at 10-15 gpm per sq ft of filter-bed area loosens the sand, agitates the bed and washes out the collected dirt to drain; takes about 10 minutes. A sight glass on the backwash outlet piping gives the operator visual indication that wash water is coming out clear.

If sufficient filtered-water storage can be provided, or if a number of filters are in battery, backwashing with filtered water is preferred. If raw-water backwash is employed, the filter is downwashed to drain for several minutes to clear the raw water and allow collection of a layer of floc at the top before the unit is returned to service. Multiport valves simplify the operator's job during backwashing; the entire cycle can be made fully automatic for a battery of filters if desired.

Silica Removal

Internal treatment within the boiler drum with phosphates, sodium aluminate or colloids has long been considered satisfactory for silica-bearing waters. Conditions within high-pressure boilers, however, are favorable to formation of hard scale in the tubes and, because of carryover, on turbine blades. These have resulted in the development of several effective and ingenious methods for silica removal.

While the chemical action is complex, silica reduction is effected by the adsorbing (blotting) action of ferric hydroxide or magnesia. For waters that require coagulation and do not contain large amounts of silica, the use of ferric sulphate as a coagulant effectively reduces silica. Recent developments indicate that magnesium oxide has a much higher silica-adsorbing power than ferric salts and equipment and processes have been reported that indicate elimination of a high percentage of silica.

Two processes for the use of magnesia (magnesium oxide) differ in that one is carried out at boiling temperature, Fig. 4, and the other, Fig. 3, depends on recirculation of a thick sludge blanket and slow upward motion of the raw water. The process is similar to upward filtration through a thick suspended filter bed of flocculent material having high adsorbing power.

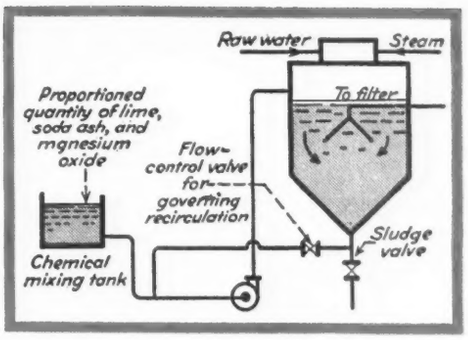


Fig. 4—Hot process (Betz) for reducing silica by recirculated magnesia sludge

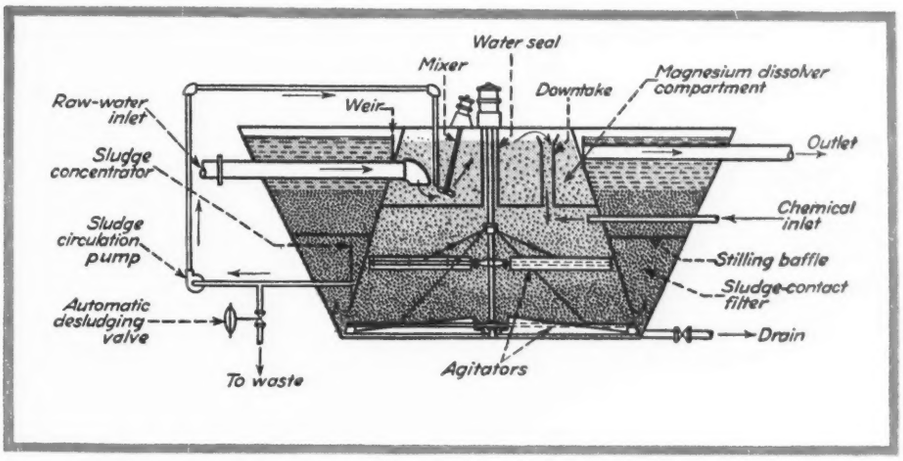


Fig. 3—Precipitator (Spaulding) designed to reduce silica content of raw water. Upward water flow passes through blanket formed by magnesia sludge, which absorbs silica

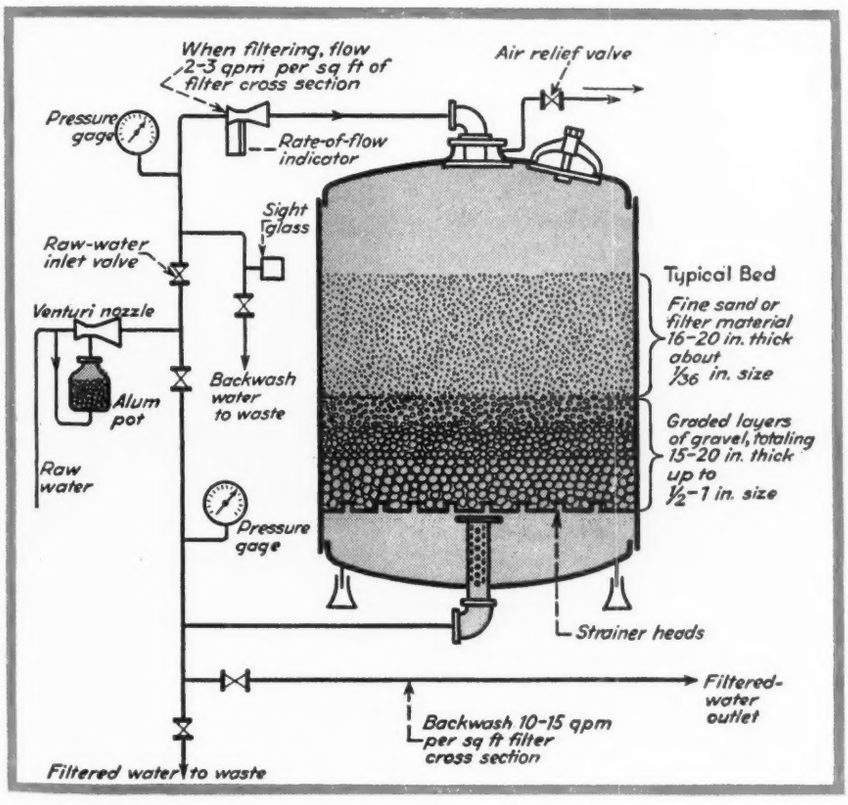

When filtering, flow 2-3 gpm per sq ft of filter cross section
Air relief valve
Pressure gage
Rate-of-flow indicator
Sight glass
Raw-water inlet valve
Typical Bed
Fine sand or filter material 16-20 in. thick about 1/36 in. size
Venturi nozzle
Backwash water to waste
Alum pot
Graded layers of gravel, totaling 15-20 in. thick up to 1/2-1 in. size
Raw water
Pressure gage
Strainer heads
Filtered-water outlet
Backwash 10-15 gpm per sq ft filter cross section
Filtered water to waste

Fig. 2—Typical vertical steel-shell pressure filter with simple alum-pot arrangement for floc formation. Gages show pressure drop; more than 5-10 lb indicates need for backwash

COLD LIME-SODA AND HOT-PROCESS

SOFTENING is a term given to the process of removing or chemically changing dissolved solids contained in natural water. An evaporator, for example, produces soft water by physical separation of vapor (containing no dissolved solids) from the remainder of the liquid. Chemical softening changes compounds of calcium, magnesium and certain other minerals to compounds that will not deposit within the boiler as scale.

Scale-producing hardness is usually caused by the bicarbonates and sulphates of calcium and magnesium. Adding lime and soda ash, in proper proportions, to waters containing these impurities in solution forms insoluble compounds of the calcium and magnesium content which can be precipitated as sludge, leaving sodium compounds as the principal impurity.

Cold Lime-Soda Softening

When the reactions are carried out at room temperature, without use of steam, the process is termed "cold". The lime reacts with dissolved CO_2 and with calcium bicarbonate to form a calcium carbonate precipitate (see page 78). Lime also reacts with magnesium bicarbonate to form insoluble magnesium hydroxide. A slight excess over the amount of lime for these reactions is supplied to react with the soda ash to form caustic soda. The soda-ash treatment changes sulphates and other noncarbonate hardness to carbonates.

In either intermittent or continuous softeners, the chemicals are introduced in proportion to the raw-water flow rate. Baffles or agitators aid distribution. Tank capacity should be sufficient to hold the water-chemical mixture from 4 to 8 hr while the sludge settles out and is removed through a system of piping. The small amount of sludge remaining in the clarified water is removed in the filter bed.

Even with a long holding time in the sedimentation tank, fine particles of sludge pass to and load the filters. This condition is improved but not entirely eliminated by adding a coagulant, such as alum, with the lime-soda. The coagulant hastens precipitation considerably. The sludge is composed principally of calcium carbonate and magnesium hydroxide, the amount of each depending on the raw-water constituents.

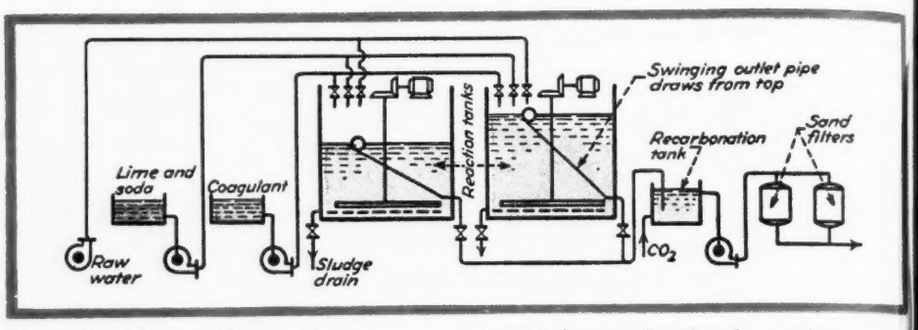


Fig. 1—Intermittent cold lime-soda treatment requires 4-8 hr retention time in reaction tanks, recarbonation with CO_2 to prevent after-deposits in filters and piping

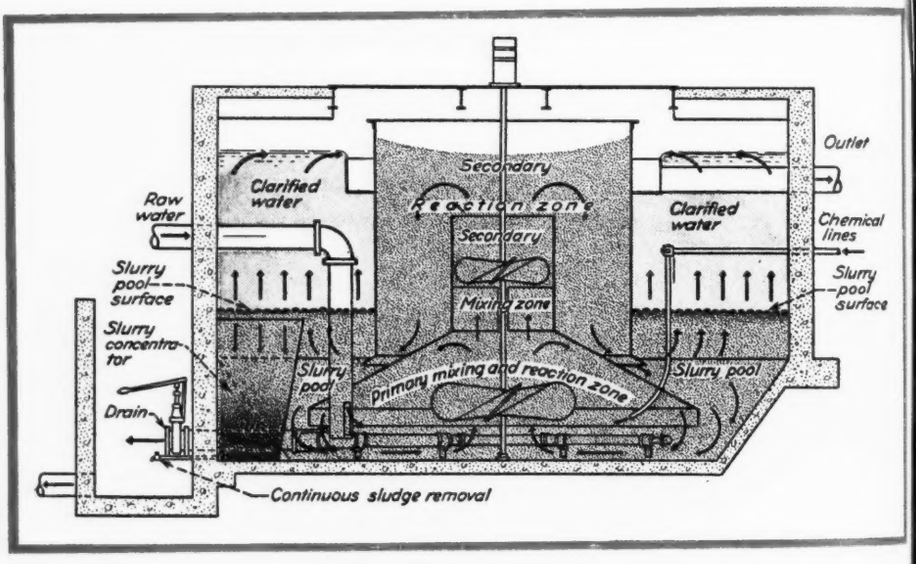


Fig. 2—Continuous cold lime-soda softener with sludge blanket *(International Filter Co)*

Because chemical reactions are slow at room or outdoor temperature, there is a tendency for the precipitate to continue to form in the filters and piping after leaving the sedimentation tank. Excess lime can be removed by recarbonation with CO_2 gas bubbled through a separate tank, Fig. 1.

With the cold process, the clarified water is never completely softened because of the long time necessary to complete the reactions and because both calcium carbonate and magnesium hydroxide are slightly soluble in water. The theoretical solubility of the two precipitates is such that residual hardness might be brought as low as 25 ppm, but rarely is reduced below 50 ppm in practice.

Improved sedimentation tanks, such as Fig. 2, obtain more complete reaction by recirculation of sludge to form a blanket through which the water filters. This promotes more intimate and thorough contact of the newly formed microscopic particles of precipitate with larger coagulated sludge masses. Water flows upward through the sludge zone.

Hot-Process Softening

Where water is softened for boiler makeup and some form of feedwater heating is necessary, the lime-soda softening process works best at a temperature at or near 212 F. The chemical reactions are the same as for the cold process but result in more rapid and complete precipitation of hardness.

The process is usually continuous, carried out in a single insulated tank. A chemical tank and pump with arrangement for proportioning the treat-

SOFTENING

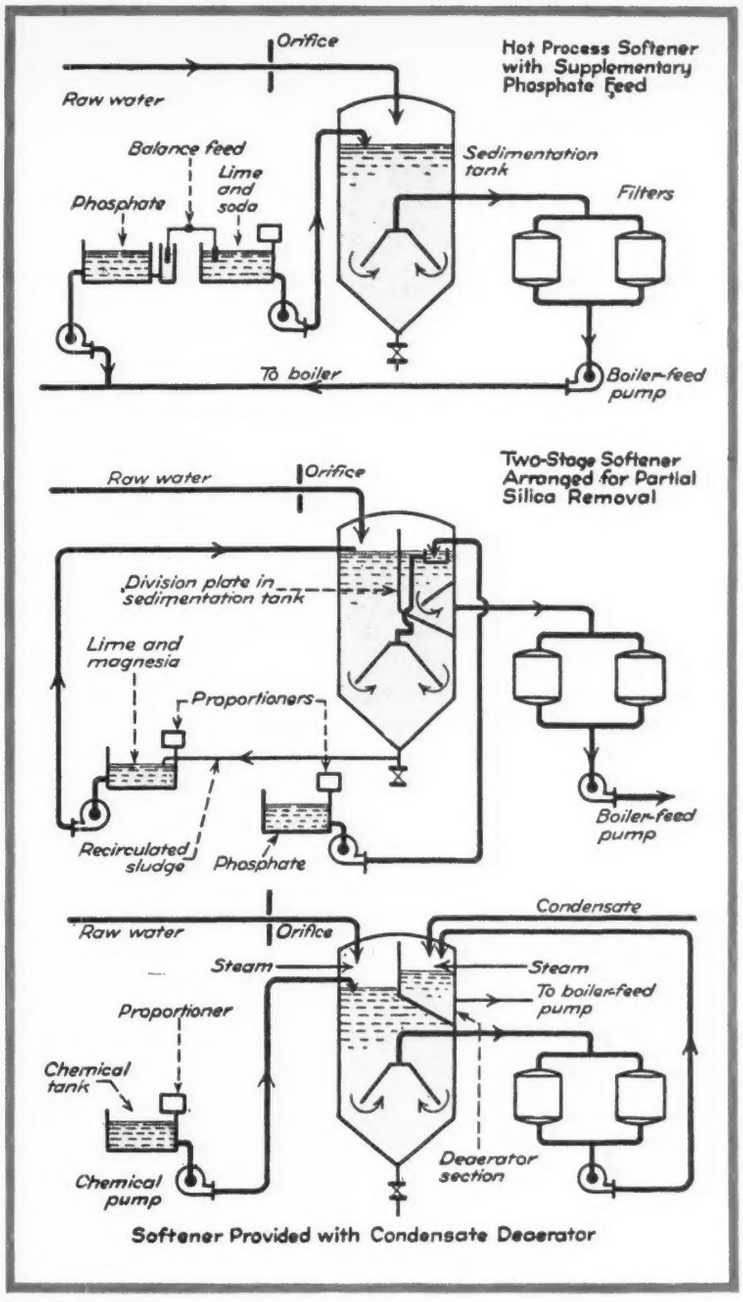
Fig. 3—Typical hot-process softener with chemical-feed proportioner, non-silicious filter and heat-saving backwash arrangement *(Cochrane Corp)*

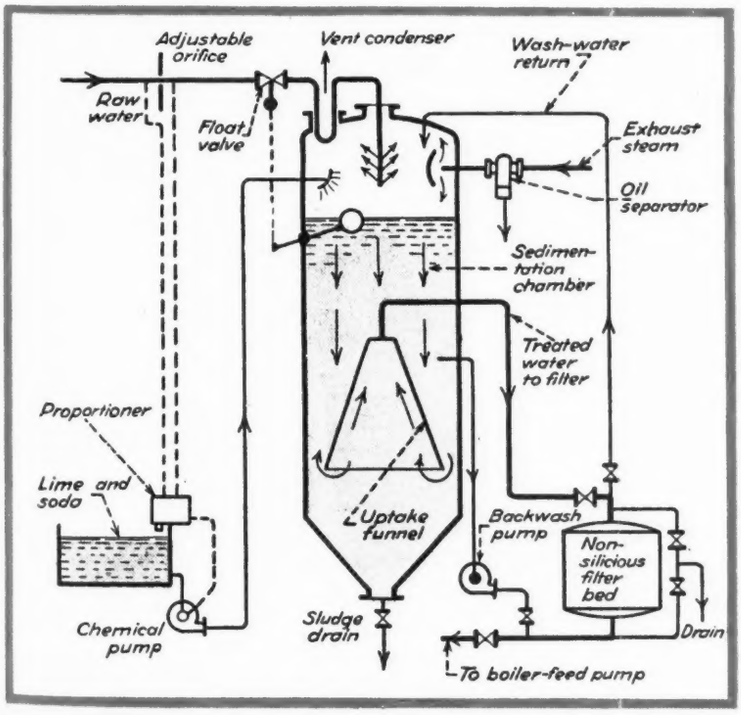
ment to the raw-water flow and a battery of non-silicious filters completes the essential equipment, Fig. 3. Exhaust steam enters the upper part of the tank and incoming raw water sprays or falls over trays to raise its temperature to over 200 F. Heating releases most of the dissolved CO_2 and oxygen before contact with the chemicals occurs.

About one hour total time for water passage through the sedimentation tank is normal. Usually no coagulant is required but one is occasionally recommended. In that case the alkalinity or acidity of the added chemical must be taken into account in determining the amounts of lime and soda ash needed.

Softened water is drawn off after a flow reversal to deposit the sludge. Filters, which remove the residue of the precipitate, should be of anthracite or other non-silicious material. Final water hardness, usually 25 ppm or less, depends on the amount of excess soda ash.

The hot-process softener can be adapted to changes in water conditions without modification of basic equipment. Proportionate increase in carbonate or non-carbonate hardness calls for an increase in chemical feed. Change in water-supply character requires different proportioning among the chemicals or perhaps substitution of other materials, such as caustic soda for soda ash,





or the addition of calcium sulphate.

Supplementary phosphate treatment, Fig. 4, is used to counteract the residual hardness inherent in the hot process. This may be accomplished by direct and proportioned chemical flow to the boiler feed or by a compartmented sedimentation tank in which the phosphate treatment becomes the second of two stages of chemical reactions. The hot process effects a reduction in silica content if the water contains appreciable quantities of magnesium salts, but silica removal can be considerably increased by adding magnesia.

Deaeration of the makeup is accomplished by preheating with steam, an essential part of the hot process.

Fig. 4—Sedimentation tank of hot-process softener often includes provisions for supplementary treatment, silica removal or deaeration

ZEOLITE—BASE-EXCHANGE AND HYDROGEN-

■ THERE ARE ONLY TWO basic pretreatments for softening boiler feedwater. Both have the primary objective of removing scale-forming calcium and magnesium compounds from the water before it enters the boiler. One method of treatment involves adding chemicals to form precipitates, as in the lime-soda process. The second depends on the ability of zeolite to exchange one metal (ion) for another, hold it in chemical combination temporarily, and give it up to a strong regenerating solution periodically. One characteristic difference between lime-soda and zeolite softening is that the former removes waste products as sludge, while the latter eliminates the impurities as a liquid solution.

Zeolite

Zeolite is a term applied to natural sands or synthetic compounds that can enter a reversible chemical reaction with hardness or impurities in water (see page 81). Natural zeolite (greensand), composed of hydrous silicates of iron, aluminum and sodium, is mined from the earth and processed until the granules are separated from clay and other impurities.

The exchange capacity, i.e., the total amount of hardness a given quantity of greensand can absorb, can be increased greatly by chemical processing under high temperature to increase porosity. Natural zeolite, either standard greensand or the high-capacity processed type, is preferred for waters containing iron compounds or acids, but can be used with almost any natural water.

Synthetic zeolites are manufactured in several compositions to provide qualities superior to or not possessed by natural greensand. Synthetic gel zeolite, prepared from sodium silicate, has high exchange capacity and is adapted to waters low in iron and free from turbidity. Carbonaceous zeolite, a carbon-base material of complex organic structure, is unaffected by acids or alkaline solutions up to pH 9.5, and temperatures up to 150 F. Newly developed resinous zeolites have high capacity and stability, contain no silica and offer some interesting possibilities for special applications.

Base-Exchange Softeners

Choice of zeolite to suit a given installation depends on acidity or alkalinity of the water, its iron and silica content, and temperature. In general, it pays to use the highest capacity zeolite that will stand up under the required operating conditions, to obtain the smallest practical softener dimensions or longer time between regenerations.

Softening takes place by simply bringing the water in contact with finely divided zeolite particles. The softening unit, Fig. 1, therefore, is much like an ordinary pressure filter provided with necessary piping and tanks for washing and regeneration.

Raw water normally flows downward through the zeolite bed at a flow rate of 5–6 gpm per sq ft per min. This softening operation continues until the rated exchange capacity of the zeolite is reached, a limit set at about two-thirds actual saturation.

When the rated softening ability of the zeolite is exhausted, the unit is backwashed at a flow of 5–7 gpm per sq ft per min to agitate the bed and wash away suspended matter and dirt from the zeolite granules. This loosens and expands the bed to such an extent that a freeboard of ⅓ to ½ the bed thickness is allowed above the normal level to insure that the zeolite will not be carried down the backwash drain.

After the zeolite has been washed clean of dirt but still retains its chemically combined calcium and magnesium, the regeneration cycle begins. A good grade of rock salt or a coarse-grain evaporated salt is made into a concentrated brine in a tank holding a sufficient quantity for one regeneration of the zeolite bed. A small ejector draws the brine from the tank and pumps it into the softener, diluting the brine to the proper strength in the process.

The salt solution, least expensive source of sodium, replaces calcium and magnesium that has combined with the zeolite during softening, forming calcium and magnesium chlorides, still in solution. Regeneration takes from 30 min to an hour depending on the type of zeolite.

The objectionable byproducts, calcium and magnesium brine and some residual salt brine, are rinsed to waste at a water flow rate of 2–4 gpm per sq ft, after which the regenerated zeolite can be returned to service. Total water use for backwash and rinse will range from 100 to 150 gal per sq ft of zeolite bed area.

The valve arrangement in Fig. 1 is schematic to illustrate the various cycles. In practice, a multiport valve controls all the necessary operations with a single motion. The entire cycle can be regulated by a time-control device for full-automatic operation. If continuous flow of softened water is re-

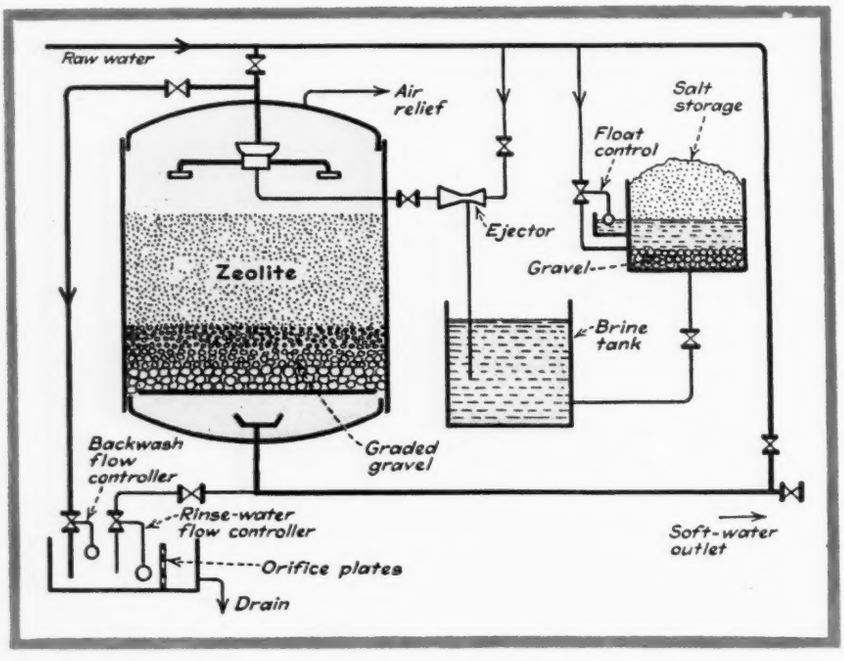


Fig. 1—Schematic diagram of base-exchange zeolite softener showing backwash valving

EXCHANGE

quired, two or more softeners are arranged in battery with their regenerating cycles staggered.

Hydrogen-Exchange Process

Carbonaceous and resinous zeolites are not dissolved by acids and hence can be regenerated with them to make hydrogen available instead of sodium. In the base-exchange process, carbonates and bicarbonates of calcium and magnesium are changed to sodium carbonate and bicarbonate, which remain in the feedwater. While the latter compounds do not form scale, they do contribute to the total solids present in the drum and require greater amounts of blowdown than would be necessary if they were removed.

With zeolite capable of supplying hydrogen instead of sodium, carbonate of hydrogen (carbonic acid) is formed which readily decomposes into water and CO_2 gas. The latter can be conveniently removed by aeration in a degasifier similar to a baffled cooling tower. No residual metallic carbonates remain in the softened water but the conversion of sulphates and chlorides to their corresponding acids lowers pH to an extent that requires neutralization with an alkali.

Neutralization can be effected by an alkali feed of caustic soda, soda ash or sodium phosphate. The more usual arrangement, however, takes advantage of the presence of sodium carbonate in water softened by sodium zeolite. By flowing part of the water supply through a sodium-zeolite and the remainder through a hydrogen-exchange softener, Fig. 2, a mixture of the softened waters can be controlled to zero hardness, considerably less total-solids content than the raw water and any desired alkalinity.

For raw water low in sulphates and chlorides, this process produces boiler feed with solids content not much greater than the product of an evaporator. If sulphates and chlorides are present in appreciable quantity and their removal is worth while, practically complete demineralization can be effected by following the hydrogen exchange with an acid-absorbing unit containing a resinous zeolite of the amine-formaldehyde type.

Combined Treatments

Typical of the ingenuity of equipment designers and water-conditioning engineers is the combination cold lime-soda and zeolite softening plant, Fig. 3, for 100% makeup in a 900-lb industrial plant. Soda ash, in this case, was found less expensive than salt. Cold lime-soda precipitates most of the hardness, pH is then corrected by acid feed from 10 to about 7.5, zeolite completes the softening, and the water passes to a deaerator. Internal treatment with phosphate and sulphite completes the cycle.

Many combinations include partial softening by pretreatment, further softening by added pretreatment, removal of silica, acid or alkali feed for correction of pH, and internal treatment.

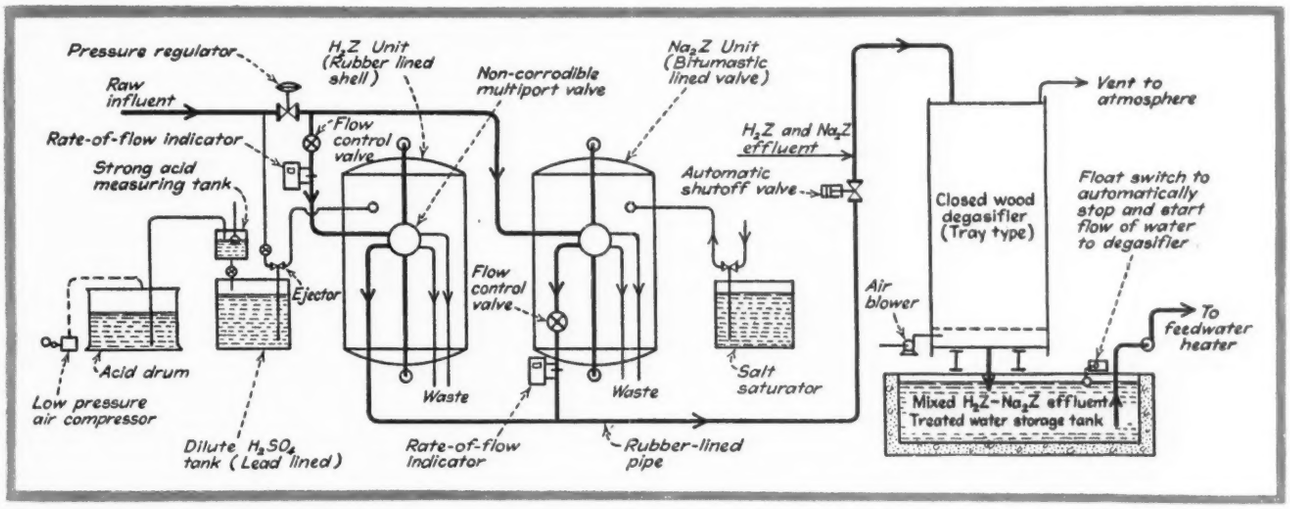


Fig. 2—Combined base-exchange and hydrogen-zeolite softener with regenerating systems and degasifier for removal of CO_2 (Permutit Co)

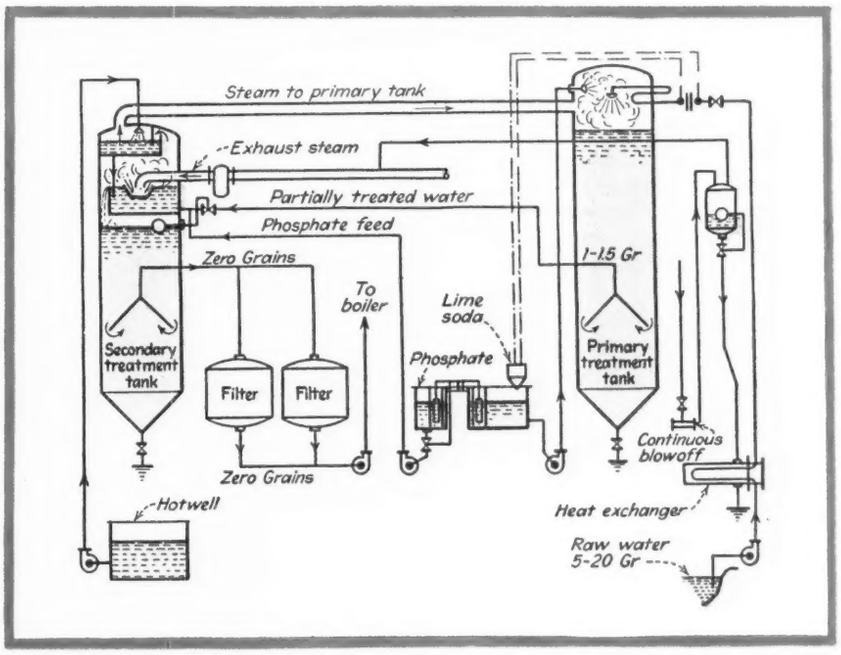


Fig. 3—A combination lime-soda and zeolite softener installation for 100%-makeup boiler plant operating at 900 lb. Progressive softening indicated by hardness quantities

CARBONATE AND SULPHATE HARDNESS,

■ UNLESS THE WATER in the boiler is in satisfactory chemical condition and remains so at all times, treatment is inadequate and troubles are inevitable. Problems of the super-pressure central station using nearly all condensate for boiler water are not those of the moderate-pressure industrial plant with a high makeup ratio. For these reasons the most important part of boiler-water conditioning is proper diagnosis; much recent development aims at finding the cause of trouble rather than in finding new remedies.

The objectives of pretreatment are simple and clearly defined, namely, to deliver clarified, softened water to the boiler-feed system. Internal treatment consists of adding chemicals to the boiler water in the drum or in the feed lines. Its objectives include prevention of deposits in feed lines, scale in the boiler itself, corrosion of the entire steam-water cycle from feed pump to heating-system radiator, carryover in steam that might cause turbine-blade deposits, and embrittlement of the boiler metal.

In addition to these, proper boiler-water conditioning should add little to the total solids content of the drum water, to keep blowdown heat-loss as low as possible. No treatment should be undertaken that does not aim at a specific trouble source. Secret formulas, universal compounds and ready-mixed treatments often add more solids to the boiler water than are actually required, unless prescribed on the basis of sound knowledge.

Certain of the factors that require internal treatment come from the condition of natural water or remain in the softened water after pretreatment. Others enter with the condensate returns. Still others are occasioned by chemicals introduced for another purpose; for example, caustic embrittlement is occasioned primarily by alkalinity introduced to prevent scale and corrosion.

Just as pretreatment reduces the need for treatment in the drum, removal of oxygen and CO_2, elimination of condenser leakage, separation of oil from condensate and general good mechanical housekeeping can greatly reduce troubles often charged to boiler-water conditioning. Where dissolved gas, oil, salt water and otherwise contaminated condensate cannot be entirely eliminated, chemical treatment in the drum can partly overcome the effects but the best way to avoid trouble lies in finding and eliminating the cause.

Carbonate Hardness

Presence of calcium and magnesium bicarbonates gives water what used to be loosely termed "temporary" hardness. Modern terminology refers to "carbonate" hardness, because the amount is measured in terms of equivalent parts per million of the hardness as though it were all calcium carbonate.

When heated, in a feedwater heater or in a boiler, the carbonate hardness (actually bicarbonates) breaks down, without the addition of any chemicals, to calcium carbonate, which forms a sludge, and magnesium carbonate, which is partly soluble and remains in the water until the continued process of evaporating steam increases the concentration above its solubility limit. At this point magnesium carbonate, too, falls out of solution as a soft sludge.

Carbonate hardness can cause deposits in heater and feed lines as well as in the drum. If these are objectionable, some form of pretreatment softening is indicated. If the precipitates are carried along to the drum without objectionable scale in the feed system, internal treatment is adequate.

Sulphate Hardness

Sulphates of calcium and magnesium, nearly always present in natural waters, add to the hardness and are determined by simple test procedures outlined on page 84. When the sulphates become concentrated by continued evaporation of steam from the boiler water, they precipitate with the carbonate sludge, cementing the mixture into a hard scale.

Sulphate hardness, because of its cementing action, requires treatment. The object of the treatment is to cause loose sludge to form instead of hard scale. The action can be strictly chemical or partly mechanical, as in colloids.

Simplest, but limited, treatment is by soda ash, see page 78. Soda ash gives up its carbonate to the calcium and magnesium sulphates, leaving in solution only harmless sodium sulphate. This treatment is limited to low-pressure boilers (under 300 lb) because soda ash breaks down into caustic soda and CO_2 at high temperature.

Other chemicals accomplish the same result as soda ash and do other desirable jobs as well. Among these, the most important are sodium aluminate and the several sodium phosphates.

Softening with phosphate is usual treatment in high-pressure boilers. The chemical action differs from that of soda ash in that the latter reacts only with the sulphate hardness while phosphate acts first on the sulphate hardness and then with all other calcium compounds present. Any excess phosphate in the boiler-water circulation insures that no scale-forming salts remain. For both carbonate and phosphate treatments, enough chemical is added to establish an excess. Phosphate treatment applies to boilers operating at any pressure and can be introduced as part of hot-process pretreatment.

Sodium aluminate is employed as a coagulant within the boiler drum to cause formation of loose sludge from the precipitates. Other coagulants, such as alum, are ineffective because of the high temperature and the relatively high alkalinity usually maintained in boiler water to prevent corrosion. In addition to its coagulating action, sodium aluminate has some softening ability so that carbonate or phosphate are reduced proportionately. In addition, sodium aluminate forms sodium, calcium or magnesium aluminum-silicates with silica, preventing it, in turn, from cementing sludge particles into hard scale.

Colloids

The action of finely divided metallic or organic materials does not proceed by a chemical exchange grain for grain and pound for pound as in the case of previously mentioned chemicals. Their complex structure and long names, as well as lack of exact knowledge of reactions with boiler water, have increased the mystery surrounding colloids as boiler treatment. They are used successfully, however, in a number of plants, particularly moderate-pressure industrials.

Colloidal particles, whether metallic or organic, are smaller than a millionth of an inch in diameter and carry an electrical charge. They are taken for granted in everyday life in milk, starch, glue and soap. Milk, for example, consists of globules of fat and protein so

COLLOIDS, OIL

small that when suspended in water, they do not settle out even after several days. The particles can be caused to cling together and form solid masses by the addition of an acid such as lemon juice or vinegar. Accepted theory explains that colloidal particles containing electric charges, adhere to precipitated solids in the boiler drum, but in no exact weight relationship. They prevent precipitate from being cemented together as scale.

Starches and tannins are protective colloids that can be dispersed in boiler water. When they are present, a greater amount of scale-forming salts can be held in the boiler water without actual scale formation. Organic colloids are made from seaweed, hemp, sugar cane and resins, to name but a few. Some appear to have selective properties favoring a reaction with calcium and magnesium. Iron and iron compounds in colloidal form have a high affinity for oxygen and are primarily oxygen scavengers although they do have some coagulating effect as well.

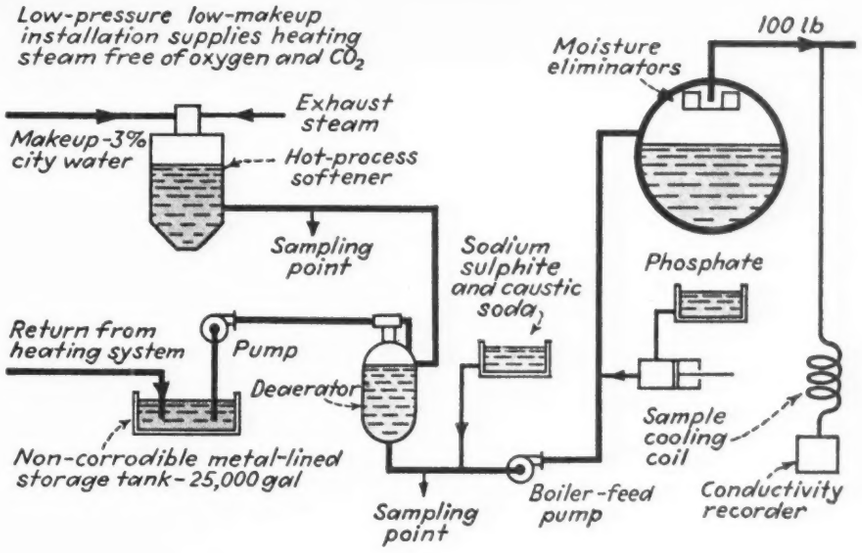
Colloidal treatments are used alone or with carbonate or phosphate to form precipitates. Phosphate aids the action of the colloid as well as starting the softening process. The presence of colloids cannot be determined satisfactorily by direct chemical test so that the use of phosphate with a colloid affords some measure of the adequacy of treatment by checking for excess phosphate, from time to time.

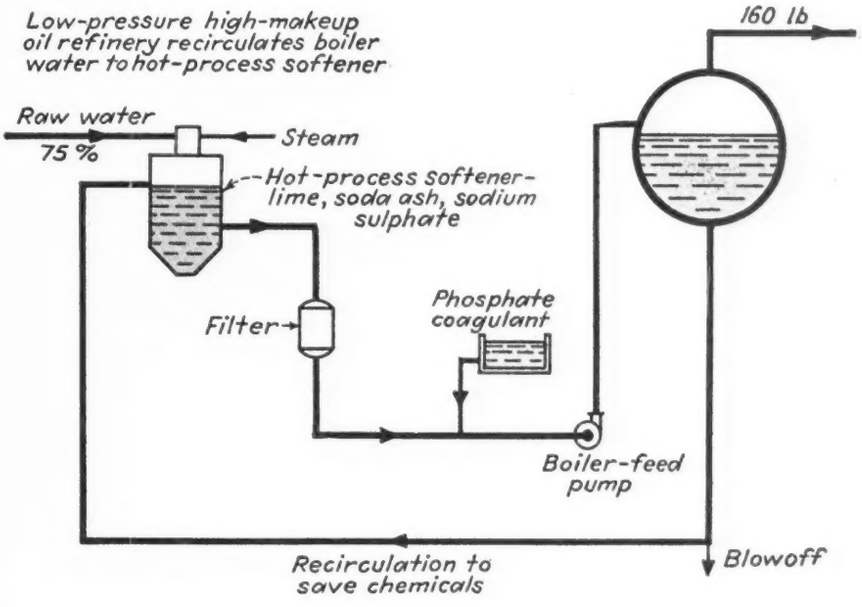
Oil

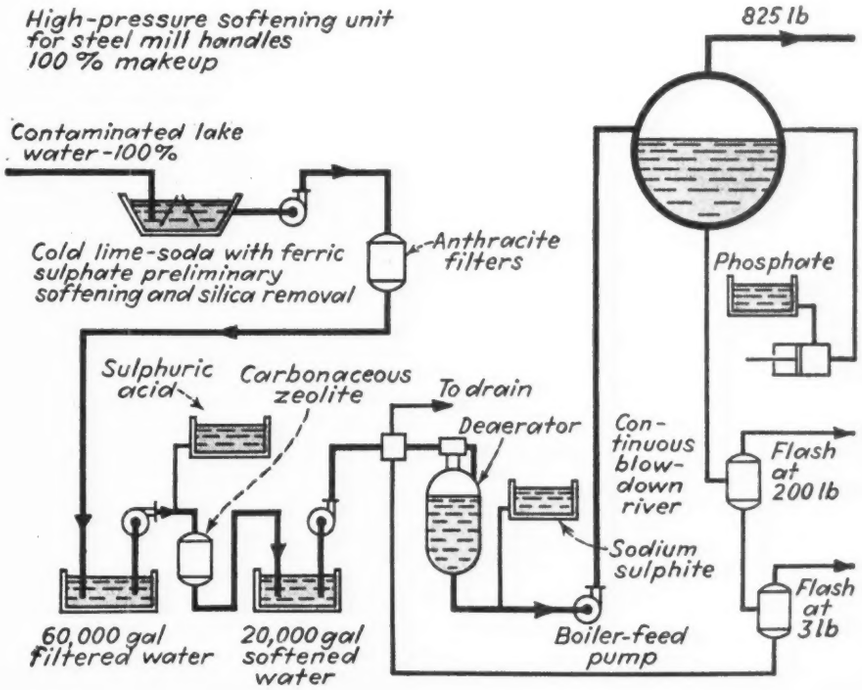
There is no generally successful internal treatment for oil-contaminated feedwater. Coagulants such as sodium aluminate and certain colloids aid in entraining small amounts of oil and grease and effecting their partial removal from the drum water. Even small amounts of oil, however, tend to contribute to priming.

One solution in plants where engine-driven auxiliaries contribute to the contamination of condensate is the reduction of oil to a minimum and the substitution of graphite lubricant for slow moving pistons such as duplex boiler-feed pumps. Oil separators filter condensate through terry cloth wound on replaceable cartridges. Another apparatus, similar to the standard pressure filter, employs a coagulant and is backwashed with caustic-soda solution.

TYPICAL APPLICATION OF WATER CONDITIONING







SILICA, CORROSION, CARRYOVER

Silica

Most natural waters contain some silica either as sediment or dissolved silicates. Also silica is sometimes introduced by sand filters, silicious zeolites or even from contact with concrete storage tanks. Unless special pretreatment is provided, most of the silica finds its way into the boiler circulation and is now considered one of the worst offenders in scale formation. Sodium aluminate and colloidal treatments are recognized aids in the control of silica within the boiler to prevent its being carried over in the steam to form hard deposits on turbine blades or in process equipment.

Certain of the old-time boiler compounds contained silicates of soda for corrosion prevention. While the silicate film that was supposed to form on the boiler metal might have had some slight resistance to oxygen attack, the silica content of the treatment certainly gave no help toward reducing scale.

Corrosion

Pitting of boiler drums and tubes is less common since the advent of widespread treatment for scale. Enough alkalinity is introduced in the softening processes to maintain pH in the boiler drum above 10.0, at which point the corrosion rate is quite low.

The complex process, corrosion, is best understood by considering that the acidity of the water determines the rate at which attack proceeds, while the content of dissolved oxygen or CO_2 determines the amount of corrosion possible. Thus corrosion can be slowed by increasing alkalinity or practically stopped by complete elimination of dissolved gas.

Both methods are employed in modern power plants. Boiler water is usually maintained in an alkaline condition, if not by the softening agents, by supplementary caustic feed. Oxygen, on the other hand, is more serious where the feedwater is mostly condensate. Consequently, large central stations deaerate feedwater to the minimum oxygen content that can be readily shown by sample test. Lower-pressure industrial plants can get along on an efficient open heater, see page 68.

Residual oxygen not removed mechanically in open heaters or deaerators, can be neutralized by chemical scavenging. Sodium sulphite, iron hydrate, tannin, and lignin are usual agents. The former unites with oxygen to form sodium sulphate, a desirable constituent of boiler water in carryover and embrittlement prevention. Application of a protective coating to drum and tubes has been found effective.

Feed lines and economizer tubes are not protected against corrosion by alkalinity in the drum, usually much higher than that of feedwater. Caustic introduced at the boiler-feed pump can assist in protecting the piping but requires continuous injection under careful control. It usually results in high boiler-water alkalinity and excessive blowdown. Recirculation of boiler water to feed-pump inlet has been tried with some success.

Other types of corrosion are found in high-pressure boilers operating at high heat-release rates. These are quite different from oxygen corrosion taking place in water solution, being caused by overheating due to poor circulation. Thick-lipped fractures are the result of repeated overheating and quenching. Grooving and gradual loss of metal result from an accelerated reaction between overheated metal and water or steam. These are detected by measurement of hydrogen in steam evolved by the direct action on metal of oxygen from the water. Continuous recorded measurement of hydrogen in steam has been developed for this purpose. Avoidance of tube burnouts from this cause calls for improvement of boiler circulation or decreasing heat input in the region of corrosion rather than chemical treatment.

Carryover

Foaming at the boiler water level at high steam-release rates tends to fill available steam space in the drum and cause carryover of water into the steam line. In many high-pressure boilers where drum dimensions must be held to an absolute minimum this condition determines the maximum amount of dissolved solids that can be tolerated in the boiler water, and hence controls the amount of blowdown required.

Mechanical separation of steam from water, chemical conditioning of drum water and elimination of foam-forming constituents are some corrective measures. Control of blowdown quantity, with consequent limitation of boiler-drum solids, effectively regulates carryover, but any increase in blowdown means added water and heat losses. If control is not effective, turbine washing or blade scraping is the unattractive alternative.

Mechanical methods include steam scrubbers in the drum, small cyclone water separators in the drum at steam outlets and external separators for saturated steam. Scrubbers wash the outgoing steam with feedwater of much lower solids content than boiler water. These have been successful in reducing superheater deposits. The newer cyclone separators have proved effective under the severe conditions of large high-pressure units. External purifiers find principal application in process industries.

The dissolved solids in the boiler water can be controlled directly by continuous blowdown, see page 71, to keep below the limit at which carryover occurs. A simple meter reading the electrical conductivity of a condensed-steam sample gives a clear indication when carryover occurs. Such a meter need not be of laboratory accuracy, as water tends to pass over in slugs the effect of which can be readily seen on a recorder chart. Indications are that a relatively higher ratio of sodium sulphate to caustic in the drum allows carrying higher total solids. This is due, it is thought, to the "drying" effect of the sulphate.

Carryover in industrial plants usually arises from contaminated condensate or raw-water supply. Oil is the principal offender and only a small amount is required to produce foaming conditions in the boiler. Oil separators and filters are the obvious remedy. Oil filters require coagulant to effect separation of the small quantities of oil that must be removed.

Embrittlement

Welding of boiler drums has eliminated the traditional focal point for caustic embrittlement cracks, at the drum seams and rivet holes. For moderate-pressure plants with riveted drums, maintenance of the ASME sulphate-carbonate ratio is still recommended procedure. For high-pressure (over 400-lb) operation, elimination of

EMBRITTLEMENT

caustic alkalinity by softening with phosphate is usual, although tannins and lignins have been found effective.

When the original sulphate-alkalinity ratios were established in 1926 the only check on embrittlement was the presence or absence of cracking in boilers in actual operation. One major practical achievement of recent years is the development of apparatus, for use in the laboratory or in operating plants, to measure the embrittling tendency of water taken from a boiler drum.

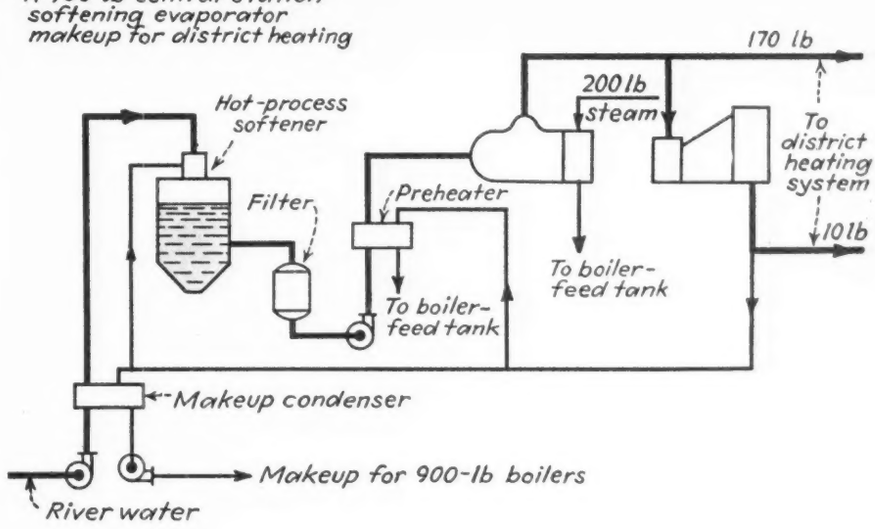
The embrittlement detector is essentially a strip of metal bolted to a block and stressed by an adjusting screw. Boiler water is taken from the drum either through a continuous blowdown connection or a separate line and permitted to seep through a small hole in the block. A minute quantity only is allowed to vaporize into steam between the stressed metal and the block resulting in an effective concentration of any solids present.

All the conditions necessary to embrittlement are present in the detector (1) boiler water becomes concentrated (2) the concentrated solution is in contact with steel under high applied stress. The chemical composition of the boiler water must have been such as to produce embrittlement if intergrain cracking occurs. All these conditions may not be present in the boiler so that the cracking of the specimen indicates only that conditions are favorable for embrittlement and some chemical treatment should be undertaken.

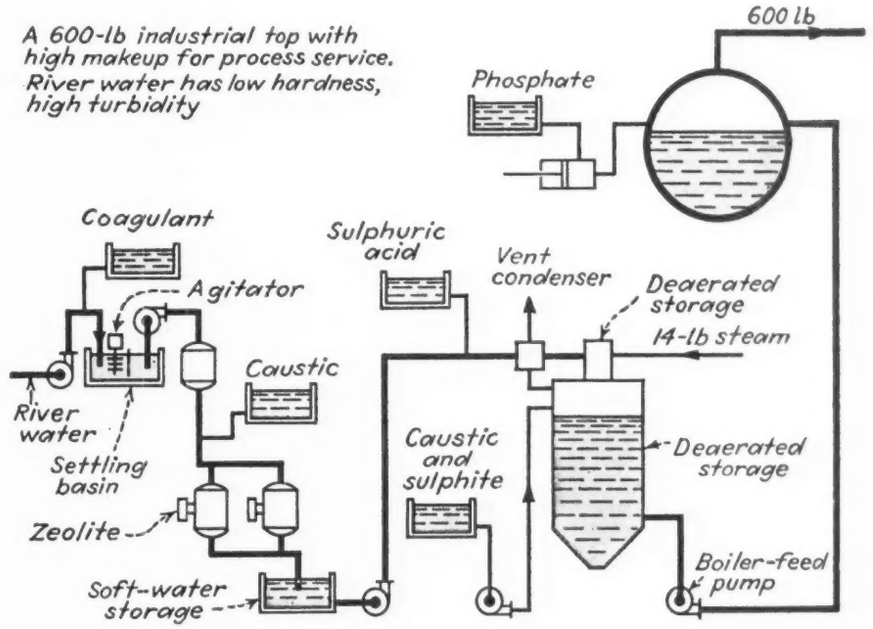
Present opinion (Partridge, Kaufman, Hall) regards sodium hydroxide as the corroding agent and silica as assisting by localizing attack to the grain boundaries. Cracking may occur with only a small concentration of caustic or it may not occur with what would be considered highly alkaline boiler water. The maintenance of the ASME ratio is not a sure safeguard against cracking even in the lower pressure range. Cracking has been shown to occur even with low silica concentrations. Presence of sodium chloride seems to have little effect on embrittlement. There is little indication that any particular ratio of phosphate to caustic will prevent cracking. The presence of tannin, however, seems, from preliminary tests, to have an inhibiting effect, particularly if nitrate is present.

TYPICAL APPLICATION OF WATER CONDITIONING

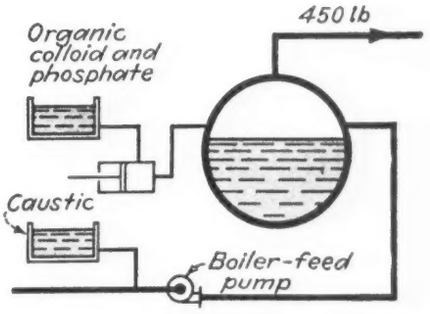
A 900-lb central station softening evaporator makeup for district heating



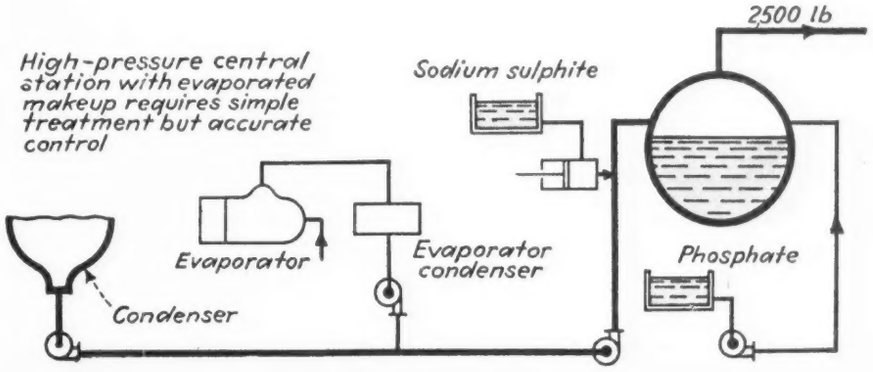
A 600-lb industrial top with high makeup for process service. River water has low hardness, high turbidity



Moderate-pressure paper mill employs colloid treatment to reduce carryover



High-pressure central station with evaporated makeup requires simple treatment but accurate control



DEAERATORS, OPEN HEATERS, EVAPORATORS

■ THE OPEN HEATER has, for many years, been standard equipment for removing oxygen from feedwater. In the days when 400 lb was top pressure, dissolved oxygen up to 0.1 cc per liter, or even higher, could be tolerated by maintaining a high pH in the boiler drum. Cast-iron economizers were standard because steel-tube units suffered from pitting. As economizers became an integral part of the boiler, oxygen had to be removed.

Increased operating pressure means higher temperature in feedwater lines and boiler circuits. Chemical reactions, including oxygen, corrosion, proceed more rapidly. At these pressures, control of corrosion by higher pH is no longer a satisfactory solution and the open heater has become the modern deaerator, a device for precise control of the mechanical oxygen-extraction process.

Deaerators

A dissolved gas such as oxygen that does not react chemically with water becomes less and less soluble as the water is heated. Water at ordinary temperatures, tap supply for example, contains much dissolved gas, seen by allowing a glass of it to stand in a warm room until bubbles form on the sides. Most of the gas is oxygen, but some CO_2 is usually present.

Most of the dissolved oxygen can be removed by simply heating water to the boiling point, whether at low temperatures and pressure, as in a condenser, or at atmospheric boiling point. Tests show that oxygen content falls to about 0.5 cc per liter by spraying water into a vacuum at a temperature above that corresponding to the vacuum, regardless of the initial oxygen content.

Remaining oxygen, experience indicates, is too high for boiler water if corrosion is to be held in reasonable check. While the original oxygen release comes from rapid formation of bubbles, the final traces must be removed by a diffusion process which takes time and requires exposure of thin sheets or atomized drops. The process is exactly the opposite of the absorption of oxygen from the air in a lake or reservoir.

Since a current of air containing oxygen blowing over an open surface will give up oxygen to the water, it

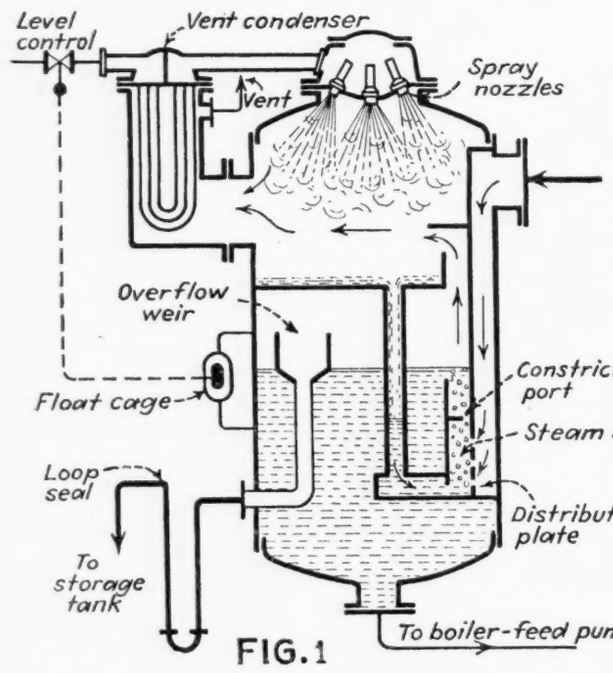


FIG. 1

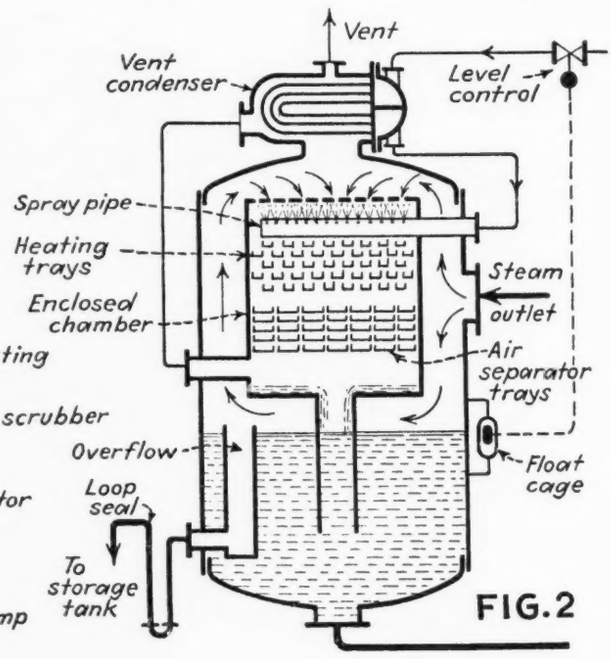


FIG. 2

Fig. 1—Spray deaerator with steam scrubber for secondary oxygen removal. Vent condenser, through which cold water enters, draws a positive and continuous current of vapor out of shell. Fig. 2—Tray unit; an enclosed center chamber contains a bank of heating and air-separating trays

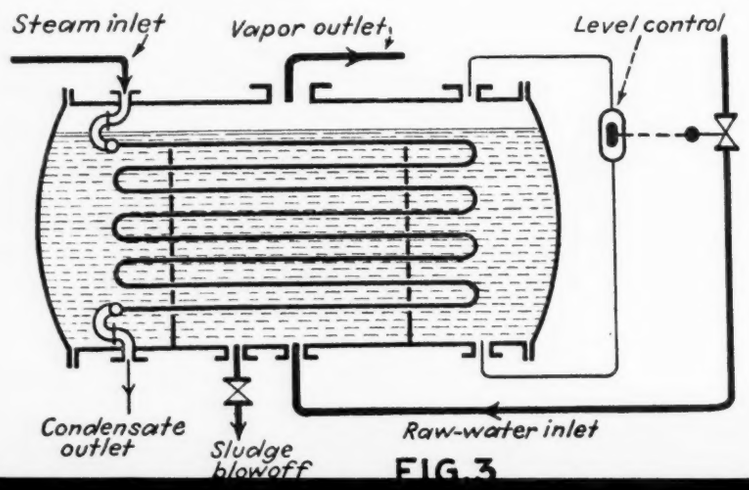


FIG. 3

Fig. 3—Horizontal evaporator with fully submerged coils. Heads are removable and entire coil assembly rolls out for cleaning

follows that oxygen will, in time, come out of the water if a current of some other gas is made to flow across its surface. In a commercial deaerator, water vapor is the other gas and a large surface is created by trays or spray. Time is an essential part of the process, as well as the maintenance of a continuous water-vapor flow, which is the function of the vent condenser. These units can reduce oxygen content to less than 0.005 cc per liter, almost the limit of sample testing by chemical means.

The deaerator itself consists of two parts, one a heating and deaerating section, the second a tank for storage of heated and nearly oxygen-free condensate. The storage tanks are sometimes large, running up into the thousands of gallons, or may contain only a small reserve if other means of storage are provided. It is important that water not "see" open air between deaerator and boiler drum.

Oxygen gets into feedwater at the condenser if the hotwell is not kept sufficiently heated to drive off whatever amount is picked up by the condensate from leakage air. Exposed surge and storage tanks, and pump glands that run under suction, are other sources. In plants where no positive provision for oxygen removal is made, control of these sources and a continuous check by sampling is essential for avoidance of corrosion. Sampling must be accomplished without exposing the condensate to atmosphere and the procedure is not as simple as other routine tests (page 84). Large stations, where the investment can be justified, keep a continuous chart record by means of an automatic oxygen recorder.

Other gases, such as CO_2 and ammonia, combine with water to form carbonic acid and ammonium hydroxide respectively. Their removal depends on the pH of the water entering the deaerator. While CO_2 is recognized as a definite contributor to corrosion, particularly in heating-system condensate returns, no separate attempt to remove gases other than oxygen is usual in power plants. Apparatus that takes out oxygen, reduces other gases.

Open Heaters

Construction of open heaters has benefited from experience with the high-efficiency deaerator. An "open" heater may be closed to atmosphere and operate at any pressure or vacuum, providing an appreciable flow of vented vapor and gas is maintained to some region of lower pressure, such as a condenser. Most open heaters are actually open to atmosphere and operate with bleed or exhaust steam just above atmospheric pressure.

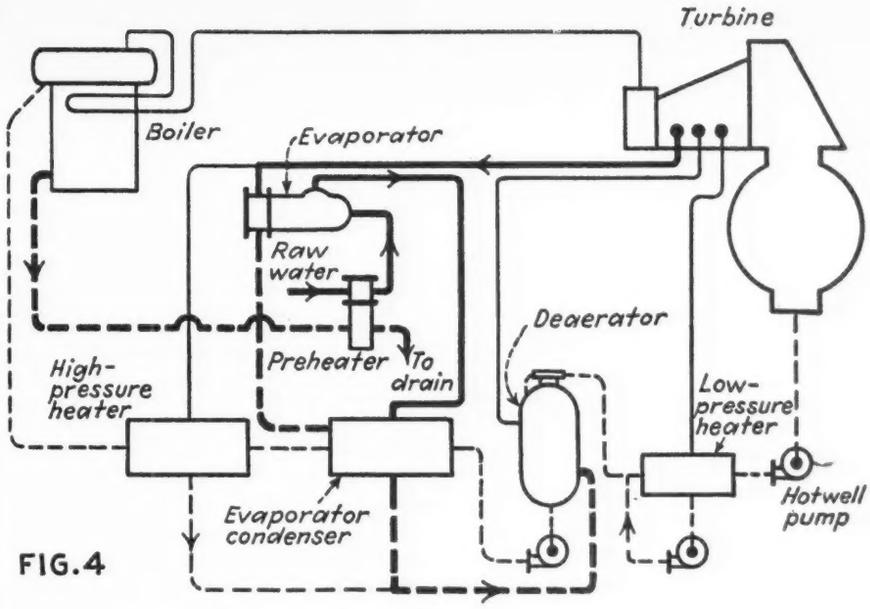


FIG.4

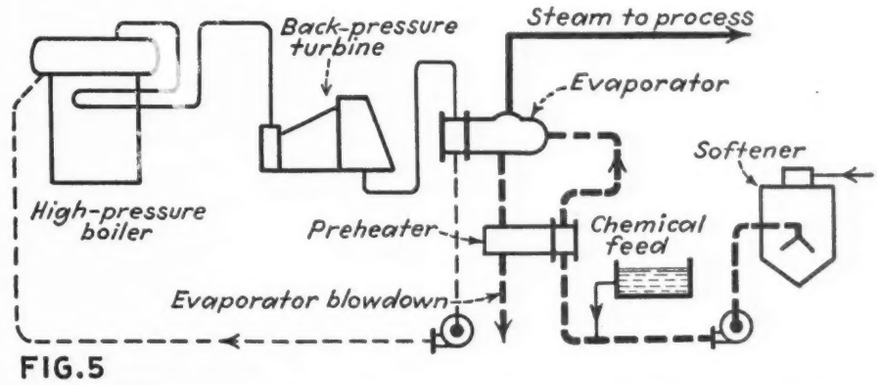


FIG.5

Fig. 4—Evaporator supplying makeup for a condensing power plant uses bleed steam, returns both condensate and makeup to the heater cycle. Preheater recovers heat from continuous-blowdown system. Fig. 5—Steam transformer (high-level evaporator) for process-steam supply enables operation of high-pressure boiler with only condensate

Evaporators

Dissolved and suspended solids can be effectively removed from makeup by distillation, a purely mechanical process of vaporizing water by heat. The apparatus, an evaporator, can be any closed pressure tank with steam coils or tubes, but the construction should provide for scale removal. Provision for condensing the vapor is usually incorporated in the feedwater-heating cycle and apparatus required is an ordinary closed heat exchanger.

Shells may stand horizontally or vertically but the tubes are usually coiled or sinuous to pack a large surface into small volume with few joints. Steam flows inside the coils and evaporation takes place outside.

Evaporated makeup is favored for large central stations, particularly those that operate at high pressure, because the distilled water contains practically no solids and the scale problems are removed from the boiler drum to the evaporator. Only two or three percent of the main steam flow has to be handled in the evaporator and the latter can be shut down for scale removal if necessary without affecting plant operation.

Process-steam supply from evaporators is becoming increasingly favored because it allows operation of high-pressure industrial boilers on a closed cycle. Part or all the exhaust from a top turbine, or bleed from a condensing unit, is turned into an evaporator where raw or treated water is vaporized directly into steam at any required pressure.

Scale and corrosion problems in evaporators are chemically like those of a boiler, except that scale forms outside the tubes (as in a fire-tube boiler) and burnouts cannot occur. Scale in-

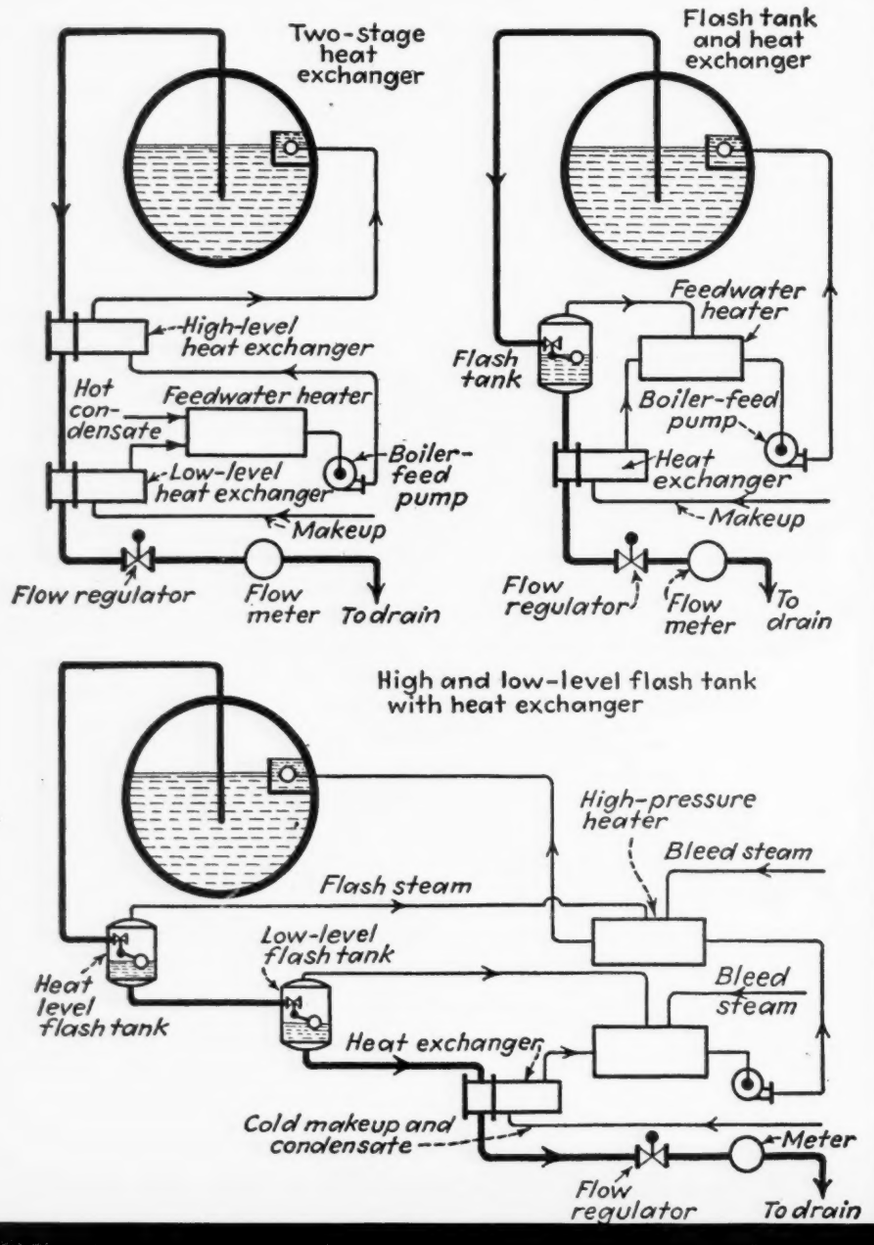
creases the temperature drop across the evaporator and hence its efficiency. Depending on character of the water supply and the type of plant in which it is used, the evaporator tubes may be allowed to accumulate scale or water can be chemically treated or softened in the same manner as boiler water. In the former case, provision is usually made for "cracking" the scale by introducing steam quickly into the tubes while they are surrounded by cold water, or the opposite, to loosen the scale around the tubes. If chemical treatment is used, sludge can be removed by blowdown just as in a boiler.

The heat efficiency of an evaporator is practically 100% in that no heat is actually lost except in blowdown. A temperature difference, or "heat head" is required, however, representing a loss of available energy in the steam. The cost of this loss of power-generating ability is small for a low-makeup plant but may be large for high makeup or for process-steam supply. An economic balance limits the application of evaporators to condensing power plants and high-pressure industrials supplying relatively low-pressure process steam.

For boiler makeup, evaporators are usually single-effect, because more makeup can be produced from a given amount of evaporator surface. A multiple-effect evaporator is an arrangement of two or more individual units in cascade so that steam produced by one is condensed in the heating coils of the next lower pressure stage, and so on. This gives more makeup per lb of steam used in the evaporators but requires that the steam pressure of each stage be lower than the last until finally passed to a condenser. Such an arrangement requires much space and offers little thermal advantage.

Use of evaporated makeup does not imply that boiler-water conditioning is not required. An evaporator is the equivalent of any other softening process with the added advantage that all solids, including chlorides and silica, are effectively removed and drum treatment is reduced to a minimum.

BLOWDOWN



■ BECAUSE ALL THE SOLIDS, dissolved and suspended, that enter a boiler remain in the drum and tubes, continued addition of makeup results in greater and greater solids concentration in the boiler water until some limit is reached beyond which operation is unsatisfactory. The limit may be in the amount of sludge, the total dissolved solids or the total alkalinity.

In general, total accumulation of dissolved solids is usually the limiting factor. These include not only the carbonate and sulphate hardness of the makeup (or sodium compounds that have replaced them in softening), but also any chlorides and silica that may have been present in the raw water, plus any chemicals supplied as internal treatment.

Every individual boiler has some limit for total dissolved solids above which priming and carryover occur. Older boilers with ample drums, usually operated at relatively low steaming rates, can tolerate 2500 to 5000 ppm of dissolved solids in drum water, depending somewhat on the ratio of sulphates to caustic. Newer high-pressure boilers, operated at high steam flows per sq ft of steam disengaging area, may require holding concentration down to 500 ppm.

All boilers are equipped with a blowoff connection of one sort or another. Usually the connection is taken from

Fig. 1—Recovery of heat from blowdown can be affected in several stages, by flashing or by closed heat exchangers

the bottom of the mud drum or the lowest point in the circulation system, and equipped with two valves, of special construction, one for throttling and the other to assure tight shutoff.

Intermittent blowdown (or blowoff) consists of opening these valves every 4–8 hours to drain some of the water from the boiler. Traditional measurement is still by "glasses," that is, the number of times the drum gage-glass-level is lowered from full to minimum safe point. By this method hot water is wasted to drain.

Because modern boilers require holding lower drum concentrations with consequent greater proportion of blowdown to steam output, methods of reclaiming the heat from blowdown water have been devised. Least equipment is needed if a small quantity is blown continuously. Some form of metering is essential, although high accuracy is not necessary.

There is no connection between continuous blowdown, undertaken to assure more accurate control of drum-solids concentration, and heat recovery from the waste water, except that the heat recovery will pay for itself if the necessary arrangements are made for regulating flow. With heat recovery, however, the regulating orifice, valve or float control, as well as any metering device, is located after heat exchanger where possible so that flashing in the regulating mechanism does not occur. This is not possible where part of the steam is flashed.

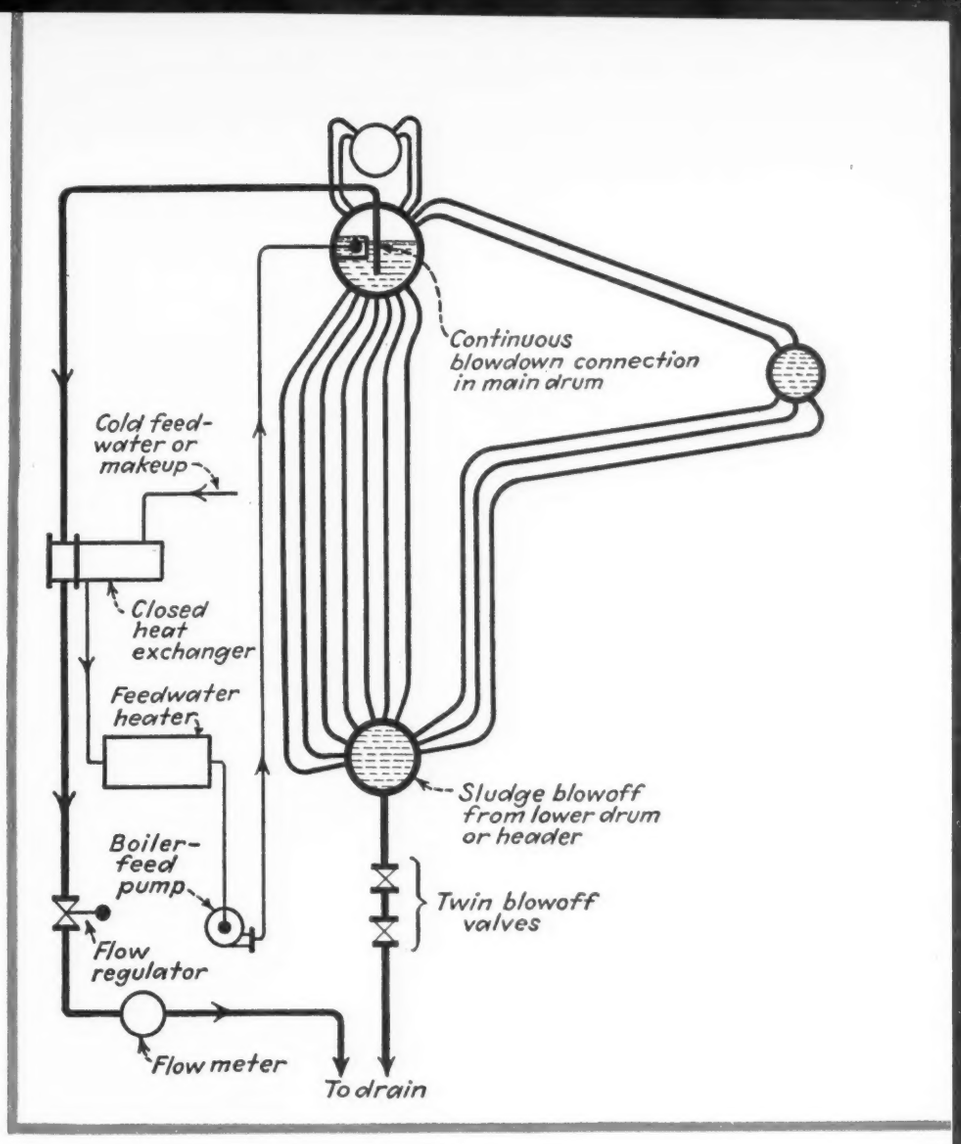


Fig. 2—Simplest continuous blowdown heat recovery requires only a single heat exchanger in cold makeup line before feedwater heater, and means of regulating flow

Continuous blowdown systems are more complex for high-pressure operation because more heat per lb of blowdown can be recovered and because high-pressure boilers usually require greater quantities to be wasted. Flashing part of the water into steam at one or more stages lower than boiler pressure recovers some of the water, as well as heat. Flashed steam can be sent to a feedwater heater or used in any other manner, as it is not appreciably contaminated after evaporating from the blowdown water. Connection for continuous blowdown should be taken from that part of the boiler circulation where solids tend to concentrate. In modern units, most of the solids are in solution and can best be taken from the steaming drum at some point well below the usual level. With this arrangement, the regular blowoff valves are opened occasionally to discharge sludge from the mud drum or lower header, but only a small quantity of water need be so blown.

Limit of solids concentration that will result in carryover cannot be determined accurately but must be held at some arbitrary value dictated by experience. Likewise, quantity of blowdown need not be estimated or measured closely, but should be held at or above a known safe value. A rough approximation to the quantity can be made directly from the ratio of the dissolved solids in makeup water to blowdown water. If blowdown contains ten times the solids of makeup, then about 10% of *makeup* (not total flow including condensate) should be blown continuously.

Where suspended solids are a large part of the total in the boiler drum (as in small plants with unfiltered raw water of low hardness), blowdown quantity may be determined by the amount of sludge rather than the dissolved solids. This is particularly true if sodium aluminate is employed as a coagulant in the drum. In other instances alkalinity of the drum water is the controlling factor. High alkalinity requires added sodium sulphate to maintain embrittlement ratios and a saving can be made in amount of blowdown by changing treatment chemicals.

Recirculation of boiler water to a hot lime-soda softener reduces the quantity of soda ash required but is limited to low-pressure operation where soda ash is the principal internal-treatment chemical. Return of blowdown water to the boiler-feed pump suction is sometimes practiced to increase pH in feed lines and economizer as a corrosion-prevention measure.

Metering flow is desirable from the standpoint of controlling solids content close to the maximum permissible without heat waste. The more efficient the heat recovery the less necessary is metering. Orifices and area meters are best adapted to indicating blowdown flow because of its high sludge content which tends to clog any meter that has moving parts. Because of the tendency of sludge to collect in heat exchangers and piping, occasional venting of the blowdown line may be necessary with the control valve or orifice bypassed to wash away accumulations.

EQUIPMENT, TESTS, CONSULTATION, CHEMICALS

■ IT IS HARDLY ENOUGH for a plant operator to acquire familiarity with the basic equipment and fundamental chemistry of boiler-water treatment. Diagnosis and prescription of specific treatment is the proper field of those with experience and specialized knowledge. Large utility systems with laboratory staffs either detail some of their personnel to follow new developments in water conditioning or contract with consultants for design specifications, patented methods or routine checks on boiler-water control.

Any plant, however small or remote, can obtain sound advice for a cost well within its means. Any of several recognized and well-organized service agencies can be called in without incurring obligation to buy chemicals, to pay a retaining fee or to purchase equipment. For their own protection, reputable consultants want to sample water, survey the plant and check operation before undertaking a definite contract for chemicals or service.

If a water problem arises in an existing plant that is beyond the experience or knowledge of the operator, it is no admission of incompetence to call in experienced assistance. The procedure, for those who endure boiler-water troubles rather than risk unknown expense from limited budgets, has been explained in literature available on request. In brief, one typical example calls for the operator to fill out a questionnaire concerning his water supply, the number and kind of boilers, and the troubles that occasioned the request for advice. Accompanying this data, a water sample from the makeup supply is sent to the water laboratory for analysis. The lab will even furnish a special bottle and mailing container for this purpose so as to be sure the sample is not chemically contaminated by a dirty bottle or soapy wash water.

Some companies prefer to send their own chemist to the plant if it is not too far from a district office. Whatever the method of handling, the assembled data enables a preliminary inventory of plant requirements. This inventory or survey represents a cost to the service company just as similar costs enter into the sale of a stoker, a coal contract or supplying lubricants. No charge is made for this service by many of the companies who derive their income from the sale of chemicals or equipment but a fee is expected by an independent consultant.

FACTS THE WATER-TREATMENT ENGINEER NEEDS TO KNOW ABOUT YOUR PLANT AND ITS OPERATION

Name, address.

Boilers: Number, make, type, size, pressure, number and size of upper drums, at what rating does boiler operate, are there water walls, economizers, water-cooled arches

Boiler operation: Season, months per year, number of boilers on line, hourly average evaporation, peak evaporation, duration of peak load, hours per day operated, average night load, average day load, hours per day at night load, hours per day at day load

Fuel: Kind, Btu value, cost, cost of handling, cost as fired, method of firing, fuel used per day in summer and winter, fuel used per year

Feed and makeup water: Source of raw makeup, percent condensate returns and percent makeup in summer and winter, average temperature of condensate, does condensate contain oil, average temperature of makeup, maximum temperature of makeup, feedwater pressure, type of boiler-feed pump, how is feedwater heated (exhaust steam, live steam, bleed steam), is there ample exhaust steam to heat feedwater to 212 F, is there an excess, type of feedwater heater (open, closed, deaerating)

Operation: Any foaming, wet or dirty steam, scale, mud, corrosion, embrittlement, leaky seams, leaky tubes, how often are boilers washed, turbined, cost of each washing, cost of each turbining, thickness of scale, is scale hard or soft, how much mud, does live steam come in contact with food products, do feed lines scale, times blown down per day, quantity of each blowdown, sketch of boiler-room layout

Equipment

The next step depends entirely on the specific recommendations of the preliminary investigation. If apparatus is necessary, the equipment manufacturer can be depended on to engineer his part of the program to assure that the customer will be satisfied with eventual operating results. If only a change of treatment is needed, the operator can elect, in most cases, to (1) obtain continued routine service and check sampling by buying chemicals from the service company, or (2) buy chemicals in the open market at generally lower costs per lb, but pay a direct fee for service required.

Tests, Consultation

An exception to this choice must be made for proprietary chemicals or patented methods available from a single source only. Many water-service companies have grown up around a single product or method. The only

option in such cases is that of accepting the recommendations at the manufacturer's terms and proving the success of the treatment by trial.

It is hardly to be expected that a water-service company would fail to include its own proprietary chemical or process. However, in the course of meeting varied plant and water conditions, most service companies utilize standard chemicals in supplementing their own products. Developments in water-conditioning have brought the several opinions into closer and closer agreement. It is possible to get almost the same prescription from several sources, for example, from the equipment manufacturer and the water-service laboratory, for comparison.

Several companies operate on the general basis of (1) prescribing pretreatment and internal-treatment chemicals, (2) instructing the operator in the standard control tests, (3) standing by until routine has been established, (4) maintaining continued contact by mail, with the operator sending in results of his own daily analyses, (5) occasional survey calls and check analyses by a district representative.

Chemicals

Since most organic treatments do not combine chemically with the boiler-water solids and are not prescribed on a weight-for-weight basis, an excess is usually prescribed. There can be no chemical test check on the adequacy of treatment. If no scale forms, no evidence of corrosion appears, no carryover is experienced and if the cost is satisfactory to the operator, there is little incentive to undertake a new procedure.

It is fortunate that boiler "compounds" rarely contain material actually harmful to the boiler. Even the traditional "Irish-potato" treatment did no damage, certainly involved little cost. The amount of benefit derived from the latter, or any such "home cooking" is highly questionable in light of present incomplete, but scientific, knowledge of the subject.

One great contribution of the water-service technologist has been development of diagnosis methods. Most of his time is spent in finding causes rather than in producing cures. For this work he employs highly specialized knowledge, has at his fingertips the experience of others, and utilizes intricate and expensive laboratory equipment if necessary. An embrittlement detector can now be taken into the boiler room to determine if drum conditions are favorable to caustic cracking.

DATA FROM WATER-TREATMENT LABORATORY

Sample taken from: raw water, feedwater, returns, softener outlet, contaminated condensate, auxiliary supply, drum

Date, time, name

Hardness	Iron, ppm
Phenolphthalein alkalinity	Hydrogen sulphide, ppm
Methyl-orange alkalinity	pH value
Free CO_2	Color
Silica	Odor
Chlorides	Suspended matter
Sodium sulphate	Turbidity, ppm
Total dissolved solids	Oil

Sulphate-alkalinity ratio

SOME NEW TOOLS OF THE WATER LABORATORY

Electrical conductivity meters determine small amounts of dissolved solids. They are used for checking amount of carryover by condensing a sample of steam and measuring its electrical resistance. This information enables setting a limit for dissolved solids in boiler water at which carryover occurs and thus establishes blowdown quantity.

Degasifying condensers remove carbon dioxide and ammonia from steam samples so that conductivity readings require no correction and can be recorded satisfactorily.

Recorders for pH and dissolved oxygen enable supervision of plant operation by detecting failure of water-treating or deaerating apparatus. They give instant indication of unusual conditions.

Hydrogen indicator and recorder measures the amount of direct combination of steam and boiler metal due to overheating. Presence of hydrogen in steam indicates dry tubes from faulty circulation.

Spectrographic (flame test) and X-ray examinations detect small amounts of unusual constituents in scale, water or steam. Presence of copper in boiler scale, for example, might indicate corrosion of brass feedwater-heater tubes.

Polarizing microscope determines crystal formation of scale and sludge. By giving indication of how scale has been formed, this instrument helps analyze the cause.

Metallographic microscope identifies metal condition. Overheating and quenching can be detected; they indicate faulty circulation. Intergrain embrittlement cracks can be distinguished from cross-grain failure due to other causes.

ATOMIC HOOKUPS

■ TABLE I LISTS most of the elements that require separate consideration in the reactions of feed and boiler water. The *atomic weights* listed are merely the weights of the atoms in terms of the hydrogen atom. For example, an oxygen atom weighs sixteen times as much as a hydrogen atom. Therefore, taking the atomic weight of hydrogen as 1, that of oxygen must be 16 to maintain this relation.

In chemical compounds the atoms of the contained elements are bound together in definite patterns as *molecules*. The formula of the molecule is the formula of the compound. Thus water is H_2O, which means that the molecule of water contains two atoms of hydrogen and one of oxygen.

It is very easy to figure the *molecular weight*—merely add up the weights of the atoms present in the molecule. Thus, the molecular weight of water is $1 + 1 + 16 = 18$. In the same way the molecular weight of sulphuric acid (H_2SO_4) is the sum of the weights of two hydrogen atoms, one sulphur atom and four oxygen atoms, thus: $1+1+32+16+16+16+16=98$.

TABLE 1—ELEMENTS

Symbol	*Element*	*Atomic weight*	*Valence*	*Equivalent weight*
Al	Aluminum	27.0	3	9.0
Ba	Barium	137.4	2	68.70
Ca	Calcium	40.1	2	20.05
C	Carbon	12.0	Variable	.....
Fe″	Iron (Ferrous)	55.8	2	27.9
Fe‴	Iron (Ferric)	55.8	3	18.6
H	Hydrogen	1.0	1	1.0
Mg	Magnesium	24.3	2	12.15
N	Nitrogen	14.0	Variable	.....
K	Potassium	39.1	1	39.1
O	Oxygen	16.0	2	8.00
Na	Sodium	23.0	1	23.0
S	Sulphur	32.0	Variable	.....

TABLE 2—ACID RADICALS

Formula	*Name*	*Radical weight*	*Valence*	*Equivalent weight*
HCO_3	Bicarbonate	61.0	1	61.0
CO_3	Carbonate	60.0	2	30.0
Cl	Chloride	35.46	1	35.46
NO_3	Nitrate	62.0	1	62.0
OH	Hydrate	17.0	1	17.0
PO_4	Phosphate	95.00	3	31.66
SO_3	Sulphite	80.00	2	40.00
SO_4	Sulphate	96.06	2	48.03

TABLE 3—ACIDS

Formula	*Name*	*Mol weight*	*Equivalen weight*
H_2CO_3	Carbonic acid	62.0	31.00
HCl	Hydrochloric acid	36.46	36.46
H_3PO_4	Phosphoric acid	98.00	32.67
H_2SO_4	Sulphuric acid	98.1	49.05
H_2SO_3	Sulphurous acid	82.1	41.05

Acid Radicals

In this molecule of sulphuric acid, the group SO_4 is called an *acid radical*. All of the acids encountered in inorganic water chemistry consist of H combined with one of these acid radicals. When acids are brought into contact with other compounds, many chemical regroupings occur, as will be shown later. In most of these regroupings the acid radical moves around as a unit. For example, in many reactions involving sulphuric acid, the four atoms of oxygen and the one of sulphur stick together in moving to some new combination.

Under the circumstances it is convenient to consider an acid radical as a chemical unit—for example, to look upon SO_4 as an entity, a sort of *submolecule* or *super-atom*.

Table 2 shows the acid radicals that are important in water chemistry. The acids of importance are in Table 3. In every case these acids are merely a combination of hydrogen with one of the acid radicals shown in Table 2.

Each table contains a column headed "Valence" and one headed "Equivalent Weight." *Valence* is a measure of the *combining power* of the given element or radical. Hydrogen is taken as the standard, with a valence of 1. Any atom or radical that will combine with hydrogen on a one-to-one basis is likewise said to have a valence of 1. For example, the formula for hydrochloric acid is HCl, showing that one atom of hydrogen combines with one of chlorine, so the valence of Cl must be 1.

Now Cl, in turn, combines with sodium (Na) to produce common salt or sodium chloride (NaCl). Since the Cl has a valence of 1, and since one atom of Cl unites with one atom of Na, the valence of Na is 1.

The formula for sulphuric acid is H_2SO_4. Since the H has a valence of 1, and since it takes two atoms of H to hold one SO_4 radical, the radical must have a valence of 2.

The *equivalent weight* shown in the last column is the number of pounds equivalent to one pound of hydrogen. This will be explained more fully on page 85.

CHEMICAL BUILDING BLOCKS

Practically every formula and reaction of interest in the field of boiler-water treatment can be represented by various combinations of these 16 "building blocks"

■ PICTURED ON THIS PAGE are 8 blue and 8 brown blocks. By combining these in various ways it is possible to present most of the compounds and reactions of interest in water treatment. The blue blocks labeled *cations* are all metallic elements with the single exception of hydrogen. *Ferric* and *ferrous* are two forms of iron. The 8 brown blocks, labeled *anions*, are all *acid radicals* (except OH and Z. The latter is explained on page 82).

To construct an actual compound, match a blue block (left) with a brown block (right). If the heights are not the same, pile up duplicate blocks of blue or brown, or both, until the heights of the two piles are equal. You will then have, in every case, an actual compound of water chemistry, with the correct number of atoms of each element.

For example, the blue cation H can be matched evenly with the brown anion OH to give HOH, which is merely a graphic way of writing H_2O, water, (Fig. 1).

Combinations of hydrogen with any of the acid radicals give acids. For example, one hydrogen atom can be matched with one atom of chlorine to form a molecule of HCl (hydrochloric acid).

On the other hand, if an attempt is made to match hydrogen with sulphate (SO_4), (Fig. 2), it will require two atoms of hydrogen to match one of sulphate, because the sulphate block is twice as tall as the H block. Matching is complete when the piles are of the same total height.

Fig. 1—H plus OH equals water, HOH, or H_2O. Fig. 2—It takes 2 hydrogen atoms to match one SO_4 radical in H_2SO_4, sulphuric acid. Fig. 3—Matching combination for aluminum sulphate is $Al_2(SO_4)_3$.

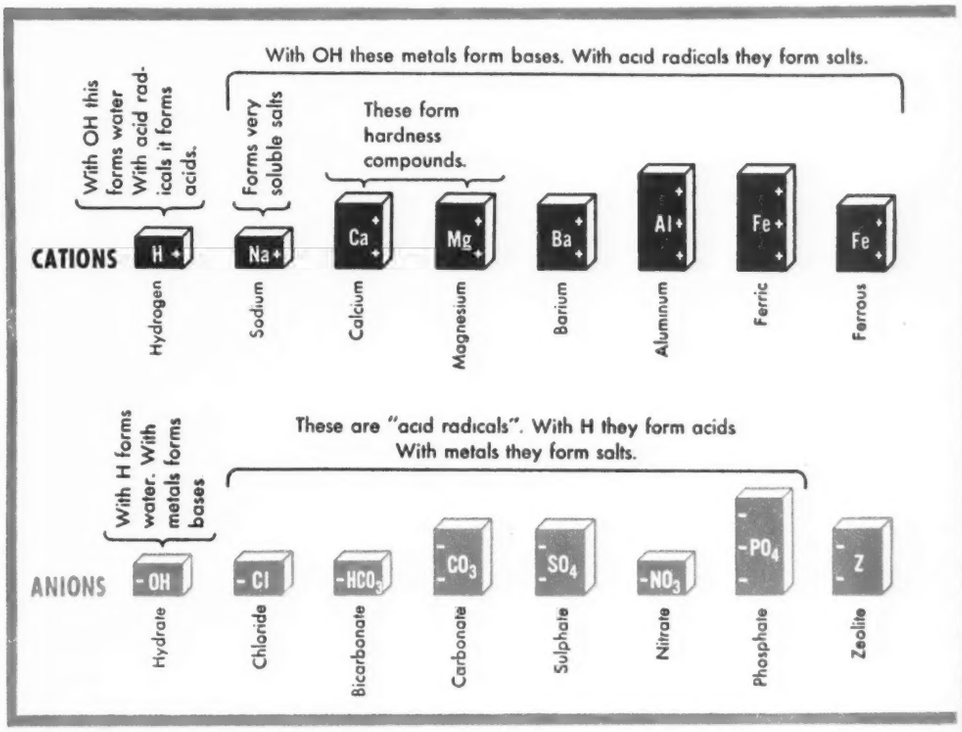


Fig. 3 illustrates the molecule of aluminum sulphate. Note that the matching combination is two atoms of aluminum to three of the sulphate radical. Thus the formula for aluminum sulphate is $Al_2(SO_4)_3$.

These blocks show graphically the valence principle outlined on the preceding page. The number of plus or minus signs on a given block represents the valence of that element. For example, hydrogen has a valence of 1, SO_4 a valence of 2, and aluminum a valence of 3. As valence is combining power, taking hydrogen as 1, the valence of oxygen is 2, because one atom will hold 2 of H in water, H_2O. The valence of OH is 1 because it matches one atom of H in H_2O. The valence of calcium is 2 because it matches 2 OH radicals in $CA(OH)_2$, calcium hydrate. Note that iron has a valence of 2 in *ferrous* compounds and a valence of 3 in *ferric* compounds.

To make the little game of blocks work out right, the heights of the blocks have been proportioned to the valences. It should be made clear that the relative size and shape of the blocks does not indicate the size or shape of the atoms or radicals.

The aluminum sulphate molecule illustrated in Fig. 3 is a good example of a so-called *salt*. A salt is a combination of a metal and an acid radical.

If we combine a metal with the OH radical we get what is known as a *base*. In general, bases react strongly with acids and may be looked upon as the opposite of acids. For example, the combination of the metal sodium (Na) and the OH radical gives NaOH, which is sodium hydrate or caustic soda, a substance that reacts strongly with acids.

COMMON COMPOUNDS

ON PAGE 75 we learned how to match the positive cations with the negative anions to produce chemical compounds. Any of the cations shown may be mated with any of the anions to give an actual chemical compound. The compounds illustrated in the present article include most of those that are important in feedwater or in water treatment.

Each group includes combinations of a single cation with various anions. In the case of hydrogen, sodium, calcium and magnesium, the combinations with zeolite are included for the sake of completeness, although zeolite is not an acid radical. These zeolite compounds represent the condition of the softening medium in zeolite softeners just before or just after regeneration. See page 82 for explanation of zeolite softening.

Except for water and hydrogen zeolite, all the hydrogen compounds shown are acids. Those of primary interest are sulphuric acid and carbonic acid.

Carbonic acid is pictured two ways—as a bicarbonate of hydrogen and as a carbonate of hydrogen. The former is probably a more correct representation chemically, but the other view is convenient for certain purposes. In carbonic acid the building block of HCO_3 or CO_3 is weak and easily broken up, particularly by heat. Heating to 212 F will break up the radical, drive off CO_2 as a gas and leave plain water (note later that calcium and magnesium bicarbonates are similarly unstable and give off CO_2 when heated).

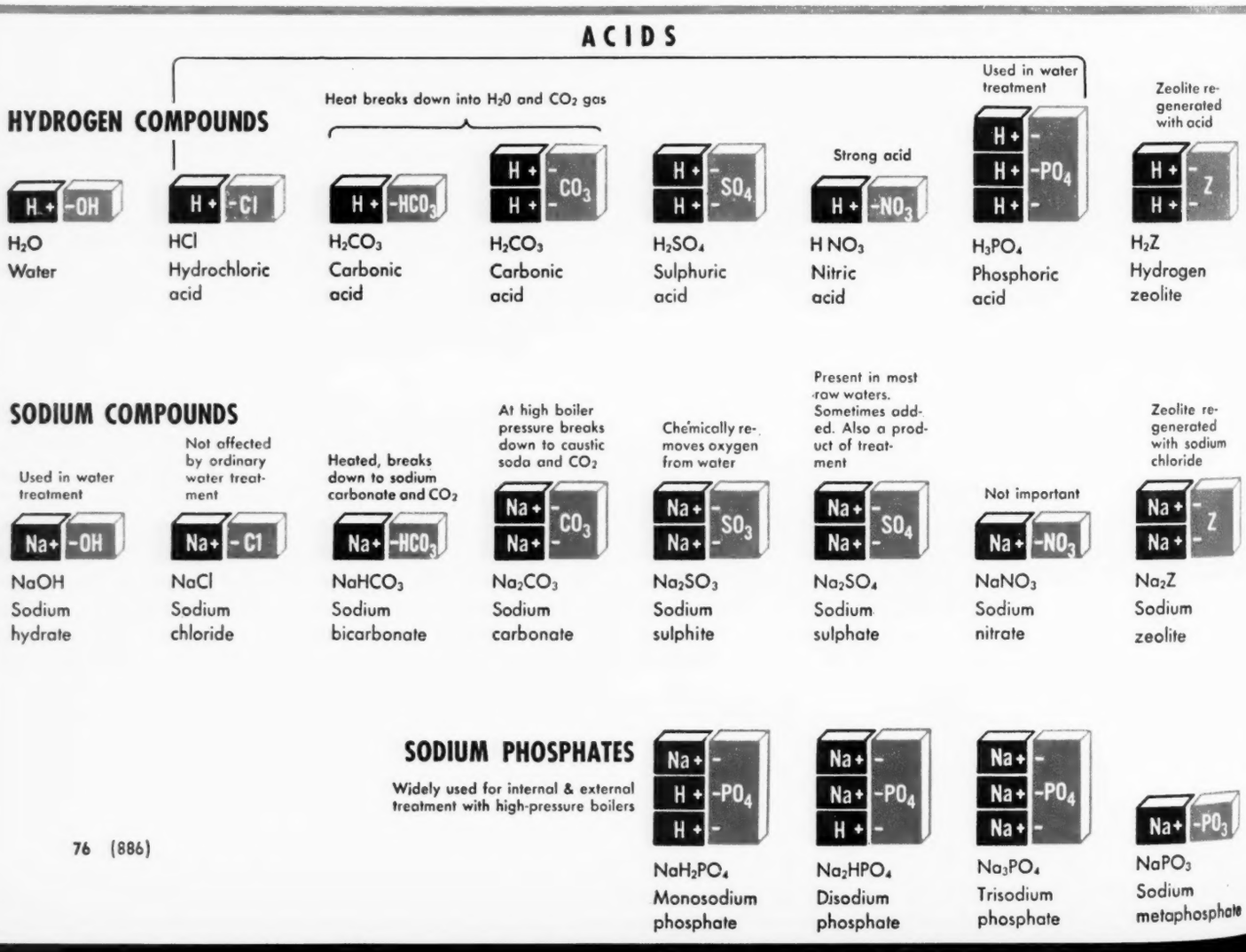
This action can be reversed; cold water will absorb CO_2 gas to produce carbonic acid. For practical purposes these effects may be viewed (in reverse order) simply as the dissolving of CO_2 gas in cold water and its subsequent driving out of solution by heat. Ordinary beverage "soda-water" is nothing but a weak solution of carbonic acid.

The family characteristic of all sodium compounds is high solubility, as illustrated by ordinary table salt (sodium chloride). Thus boiler water rarely concentrates to such a point that the sodium compounds are precipitated or deposited in the boiler (except in seams of outside caulked riveted joints). Because of this high solubility, none of the sodium compounds is scale forming.

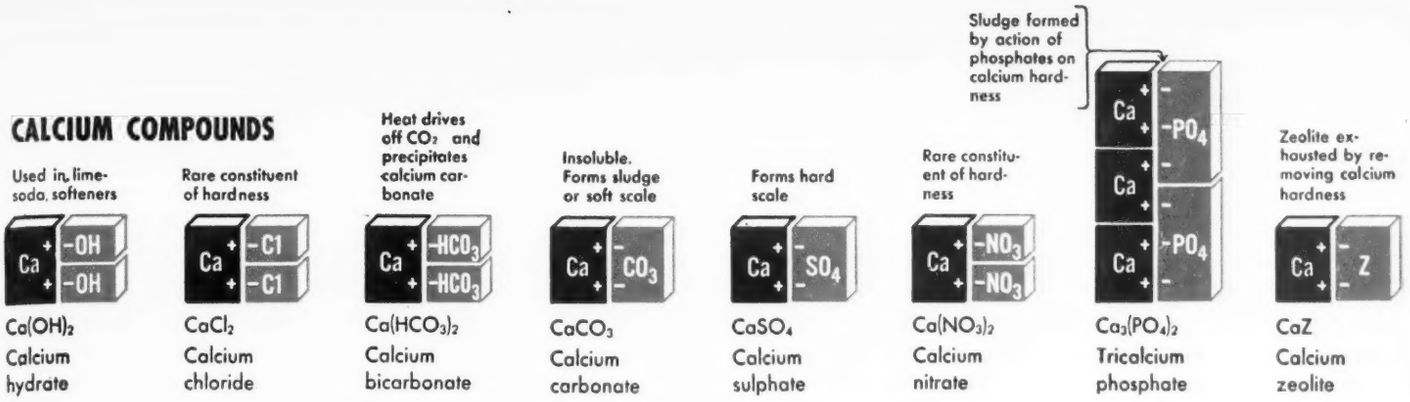
In addition to the sodium compounds found in the raw water and not removed by treatment, several are commonly added by the water treatment. For example, any of the sodium compounds pictured can be the product of zeolite treatment of the corresponding compounds of calcium or magnesium.

Sodium carbonate is commonly present in the boiler water as a residual of soda-ash treatment either outside or inside the boiler. Additional sodium carbonate may result from the breakdown, by heat, of the sodium bicarbonate introduced by the zeolite treatment of water containing calcium bicarbonate or magnesium bicarbonate. Sodium hydrate in boiler water may be a residual of sodium-hydrate treatment or of the partial breakdown of the carbonate to the hydrate at high boiler-water temperature.

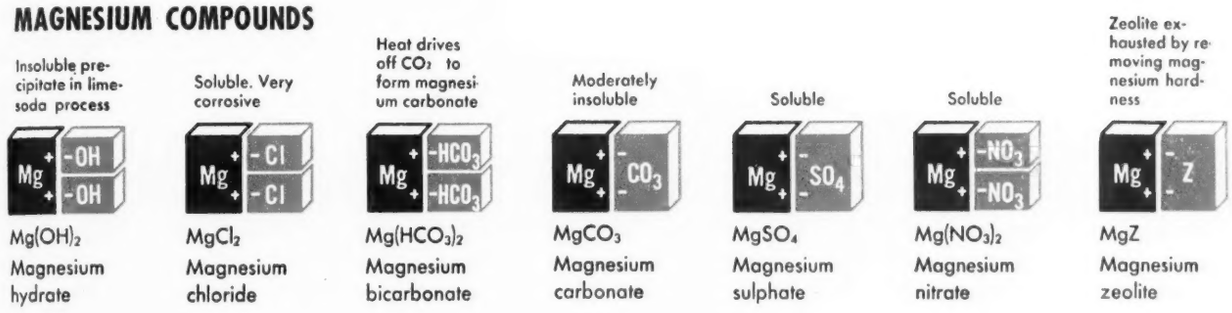
Sodium sulphate may be an unsought byproduct of softening treatment, or it may be deliberately produced in, or added to the water to inhibit the em-


ACIDS
HYDROGEN COMPOUNDS
Heat breaks down into H_2O and CO_2 gas
Used in water treatment
Zeolite regenerated with acid
H_2O Water
HCl Hydrochloric acid
H_2CO_3 Carbonic acid
H_2CO_3 Carbonic acid
H_2SO_4 Sulphuric acid
Strong acid
H NO_3 Nitric acid
H_3PO_4 Phosphoric acid
H_2Z Hydrogen zeolite
SODIUM COMPOUNDS
Used in water treatment
Not affected by ordinary water treatment
Heated, breaks down to sodium carbonate and CO_2
At high boiler pressure breaks down to caustic soda and CO_2
Chemically removes oxygen from water
Present in most raw waters. Sometimes added. Also a product of treatment
Not important
Zeolite regenerated with sodium chloride
NaOH Sodium hydrate
NaCl Sodium chloride
$NaHCO_3$ Sodium bicarbonate
Na_2CO_3 Sodium carbonate
Na_2SO_3 Sodium sulphite
Na_2SO_4 Sodium sulphate
$NaNO_3$ Sodium nitrate
Na_2Z Sodium zeolite
SODIUM PHOSPHATES
Widely used for internal & external treatment with high-pressure boilers
NaH_2PO_4 Monosodium phosphate
Na_2HPO_4 Disodium phosphate
Na_3PO_4 Trisodium phosphate
$NaPO_3$ Sodium metaphosphate

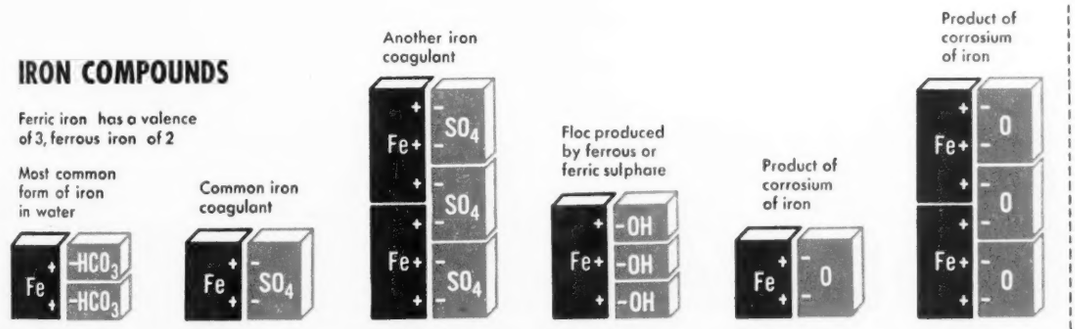
CALCIUM COMPOUNDS



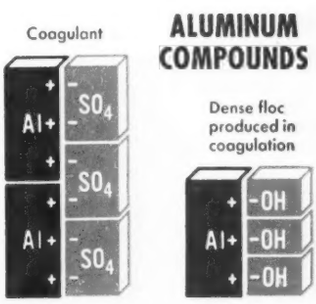
MAGNESIUM COMPOUNDS



IRON COMPOUNDS


Ferric iron has a valence of 3, ferrous iron of 2
Most common form of iron in water
Fe $-HCO_3$ $-HCO_3$
$Fe(HCO_3)_2$ Ferrous bicarbonate
Common iron coagulant
Fe SO_4
$FeSO_4$ Ferrous sulphate
Another iron coagulant
Fe+ SO_4 SO_4 Fe+ SO_4
$Fe_2(SO_4)_3$ Ferric sulphate
Floc produced by ferrous or ferric sulphate
Fe+ -OH -OH -OH
$Fe(OH)_3$ Ferric hydrate
Product of corrosium of iron
Fe O
Fe O Ferrous oxide
Product of corrosium of iron
Fe+ O O Fe+ O
Fe_2O_3 Ferric oxide

ALUMINUM COMPOUNDS



brittling effect of sodium carbonate and hydrate. Again, sodium sulphate is an end product of the chemical removal of oxygen from water by sodium sulphite.

Pictured, also, are four forms of sodium phosphate widely used for water conditioning, particularly for high-pressure boilers (see page 81).

At the opposite extreme from the highly soluble and non-scaling sodium compounds are the frequently insoluble and scale-forming compounds of calcium and magnesium. However, the bicarbonates and sulphates of both calcium and magnesium are fairly soluble at room temperature, thus making it possible for them to be brought into the boiler house with the makeup. Heat precipitates both calcium bicarbonate and calcium sulphate, but in entirely different ways. The effect of heating calcium bicarbonate to boiler temperature is to drive off the CO_2 gas and precipitate the carbonate as an insoluble sludge.

At boiler-water concentrations, and at boiler temperatures well above 212 F, the calcium sulphate is deposited as hard scale.

Magnesium sulphate is much more soluble than calcium sulphate, and does not form scale at the usual boiler-water concentrations.

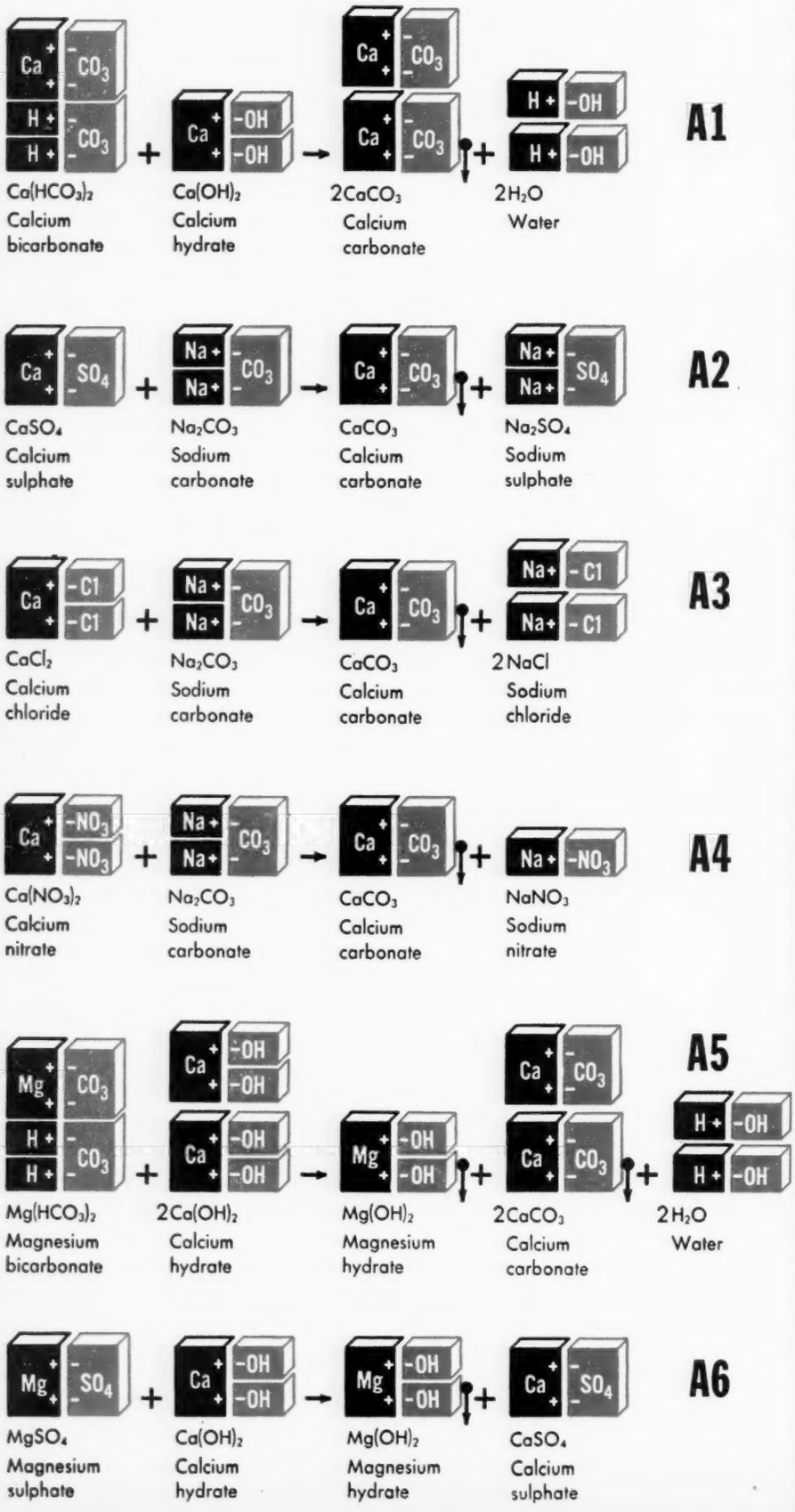
Tricalcium phosphate is the fine precipitate produced by treating calcium hardness with trisodium phosphate, or with monosodium or disodium phosphate plus caustic soda.

As already noted on page 75, iron has two valences, 2 in *ferrous* compounds and 3 in *ferric* compounds. Where iron occurs in untreated water it is most commonly in the form of ferrous bicarbonate. Both ferric and ferrous sulphate are used as coagulators in the outside treatment of water. With lime or caustic soda the ferric sulphate produces a dense *floc* of ferric hydrate which helps remove all types of suspended matter. The ferrous and ferric oxide are products of iron corrosion.

Aluminum sulphate is a coagulant and produces a dense floc of aluminum hydrate, which helps settle all types of solids suspended in the water. The aluminum compounds are shown here in simplified form.

TYPICAL REACTIONS OF WATER

A—Lime and Soda Treatment



■ WHEN TWO OR MORE chemical compounds are brought together they often react mutually to produce new compounds. Such an occurrence is called a "reaction," and can be pictured by a chemical equation. On the left side of the equation are the original compounds. On the right are those remaining after the reaction. Each compound is expressed by the formula for its molecule. Before each molecular formula is a number indicating the relative number of that particular molecule.

In every chemical equation the left and right sides must balance absolutely, atom for atom. Every atom present at the start of the reaction must be accounted for at the end.

The "building block" technique used in the two previous articles can help us picture the chemical reactions of water treatment, because most of the acid radicals go through unchanged. Thus almost all the chemical reactions with which we are concerned can be pictured by a mere changing around of the "cation" and "anion" building blocks shown on page 75.

The chief exceptions to this simple block shifting occur in certain cases where carbonates and bicarbonates are heated and give off CO_2. These are discussed on page 83.

The reactions pictured here are typical of those occurring in water softening and conditioning, and include the great majority likely to be of interest to power engineers. For convenience they are divided into the following classifications: *A*—Reactions of lime and soda treatment; *B*—Reactions of caustic soda; *C*—Typical reactions of phosphates; *D*—A typical reaction of sodium aluminate; *E*—Reactions of sodium zeolite; *F*—Reactions of hydrogen zeolite; *G*—Breakup of carbonates and bicarbonates by heat.

The simplest type of reaction is typified by *A2*, showing how sodium carbonate (soda ash) transforms calcium sulphate hardness. Note here that the reaction is nothing but a simple swapping of partners, as in a square dance. The calcium loses its sulphate radical and picks up the carbonate radical from the sodium. The sodium does the opposite. Because the calcium carbonate thus produced is insoluble, it precipitates out of the solution as indicated by the downpointing arrow.

TREATMENT

On these six pages note that each compound in the equation is perfectly balanced as to valences and is generally one of the compounds pictured on pages 76 and 77. Note, also, that each atom on the left side of the equation is found again on the right—also that each radical goes through unchanged (except where carbonates and bicarbonates break up with evolution of CO_2 as illustrated on page 83).

In general, weights have been omitted for lack of space, but the following example shows how they are figured:

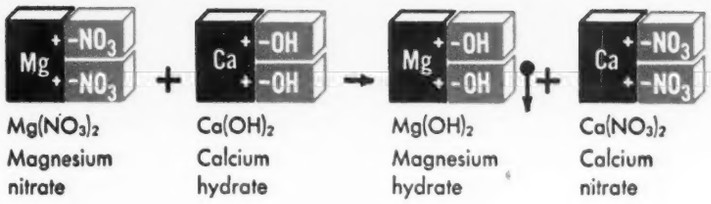
$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$$
$$136mw + 106mw = 100mw + 142mw$$
$$1\ lb + 0.78\ lb = 0.74\ lb + 1.04\ lb$$

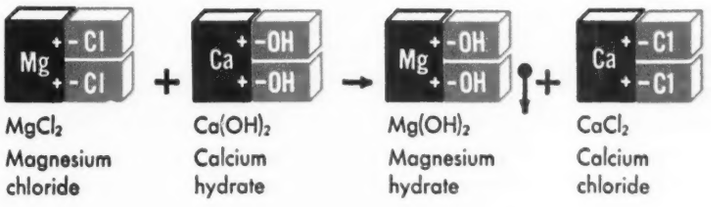
The molecular weights in the second line are taken from page 86. The third line is obtained by dividing the second line by 136 (remembering that an equation is still an equation if both sides are divided by the same number). This gives at once the other weights corresponding to one pound of the calcium sulphate.

Suppose each 24 hours we feed to a boiler 11,500 lb of raw makeup containing 120 ppm of calcium sulphate. Remember that 11,500 lb = 0.0115 million lb; then total calcium sulphate supplied in raw water will be $120 \times 0.0115 = 1.38$ lb. This would appear to require $1.38 \times 0.78 = 1.076$ lb of sodium-carbonate feed per day.

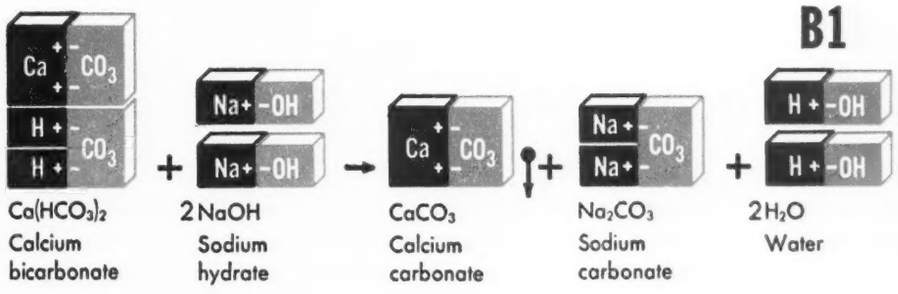
Actually certain practical allowances must be made in computations of this sort. In some cases, for example, an excess of chemical must be present to insure a relatively complete reaction. Another allowance is required wherever the commercial chemical is impure or where it contains water as "water of crystallization" or otherwise. In the present case 1.076 lb of pure sodium carbonate would give a chemical balance of total weights.

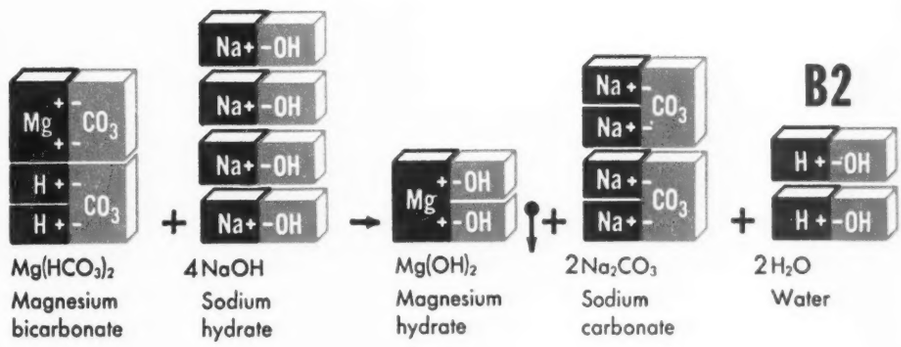
The commercial form of sodium carbonate is soda ash. This contains no water of crystallization and is relatively pure, so that no correction need be made for impurity or dilution. Nevertheless the amount supplied would actually be greater than the computed 1.076 to provide the excess needed for adequate softening. With certain other water-softening reagents, such as lime and phosphates, large allowances must be made for impurities or for water of crystallization. All reactions

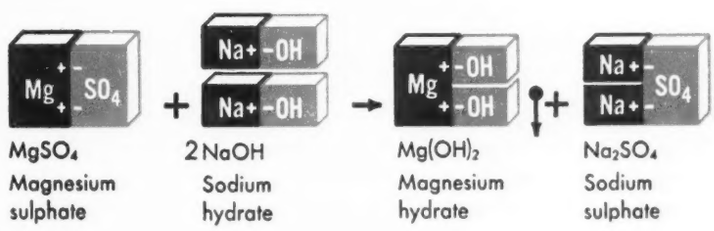


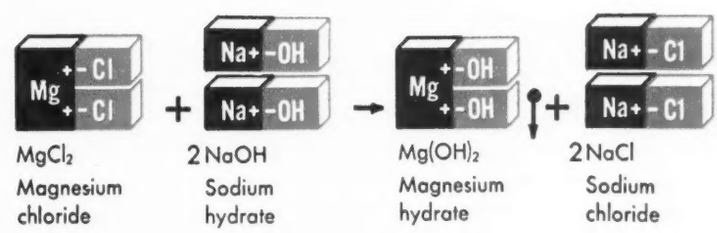


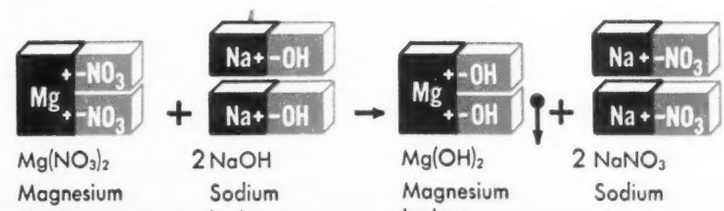
B—Reactions of Caustic Soda

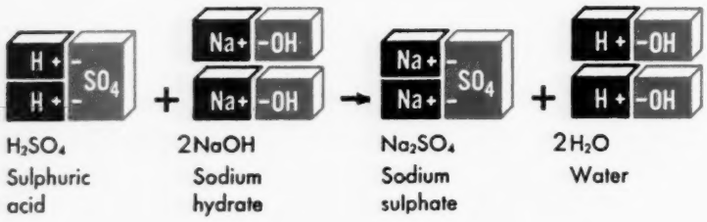








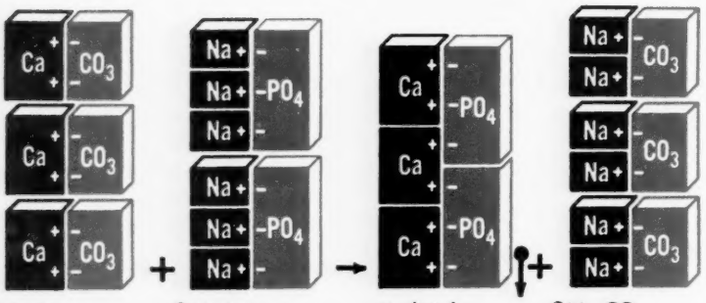




H_2SO_4 Sulphuric acid + $2NaOH$ Sodium hydrate → Na_2SO_4 Sodium sulphate + $2H_2O$ Water

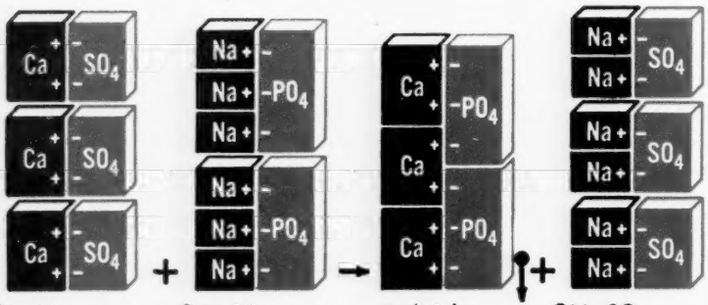
B6

C—Reactions of Phosphates



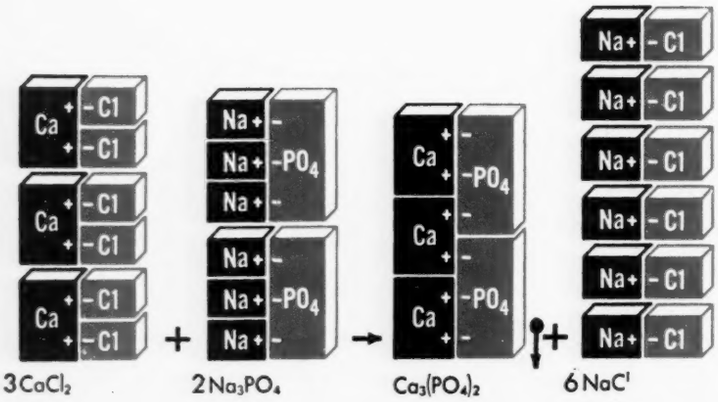
$3CaCO_3$ Calcium carbonate + $2Na_3PO_4$ Trisodium phosphate → $Ca_3(PO_4)_2$ Tricalcium phosphate + $3Na_2CO_3$ Sodium carbonate

C1



$3CaSO_4$ Calcium sulphate + $2Na_3PO_4$ Trisodium phosphate → $Ca_3(PO_4)_2$ Tricalcium phosphate + $3Na_2SO_4$ Sodium sulphate

C2



$3CaCl_2$ Calcium chloride + $2Na_3PO_4$ Trisodium phosphate → $Ca_3(PO_4)_2$ Tricalcium phosphate + $6NaCl$ Sodium chloride

C3

shown on these six pages are based on the pure concentrated chemical in dehydrated form (that is, without any water of crystallization). To get the weights of commercial chemical required for any given reaction, use the factors given on page 86.

Lime and Soda Treatment

In lime and soda softeners, the hydrated lime (calcium hydrate) is used to treat the calcium bicarbonate and magnesium bicarbonate hardness plus any other magnesium compounds that may be present. The soda ash (sodium carbonate) is used to treat the other calcium compounds, chiefly the calcium sulphate plus the calcium compounds formed by the reaction of lime with magnesium sulphate and chloride. Equations *A1* to *A4* ,inclusive, are the calcium-compound reactions, and *A5* to *A8* the magnesium reactions. *A1* shows that when the calcium bicarbonate is treated with lime, both the calcium in the hardness and in the added lime are precipitated together as insoluble calcium carbonate.

When magnesium bicarbonate is similarly treated (*A5*) the magnesium is precipitated as the insoluble hydrate, while the calcium in the lime supplied is precipitated as calcium-carbonate sludge.

Equation *A2* shows how soda ash reacts with calcium sulphate (permanent hardness) to form a precipitate of calcium-carbonate sludge, leaving highly soluble sodium sulphate in the water. When magnesium sulphate, nitrate or chloride is treated with lime (*A6*, *A7*, *A8*), the precipitate is magnesium hydrate in every case. Reaction *A6* produces calcium sulphate in the water, which in turn requires further treatment according to reaction *A2*.

Reactions of Caustic Soda

Under certain conditions caustic soda (sodium hydrate) may be substituted for lime and soda ash. Equations *B1* to *B6* show some of its common reactions. Note that the precipitation of temporary hardness by sodium hydrate (*B1* and *B2*) produces sodium carbonate which can then react with the permanent hardness, (if any is present) as shown in *A2*. Caustic soda should not be used alone for bicarbonate water unless the water contains enough calcium sulphate to use up the sodium carbonate produced in this way. In all cases the caustic soda precipitates magnesium compounds as magnesium hydrate (*B3*, *B4*, *B5*).

The neutralization of sulphuric acid

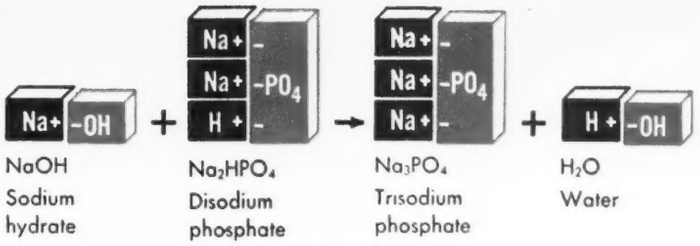
by caustic soda is shown in *B6*, the end products being sodium sulphate and water.

Reactions of Phosphates

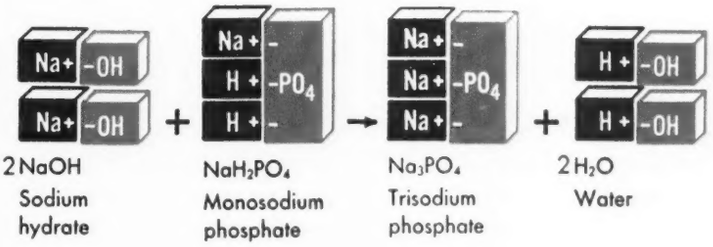
The many possible phosphate reactions are briefly exemplified by typical reactions of calcium compounds with trisodium phosphate. In *C1*, *C2*, and *C3* the phosphate is precipitated as a fine insoluble non-settling sludge of tricalcium phosphate, while the acid radical originally attached to the calcium combines with sodium to make a soluble salt. *C4* and *C5* show how caustic soda converts both the disodium phosphate and the monosodium phosphate to trisodium phosphate. The displaced hydrogen combines with the hydrate to form water.

Phosphates are extensively used for secondary internal treatment where the boiler pressure exceeds 250 lb, as it is impossible to maintain sufficient sodium carbonate in the boiler water at higher pressures to prevent calcium scale (because the heat is constantly breaking down the carbonate to the hydrate). Phosphates are used under such conditions because they are stable. The various phosphates available (shown also, on page 77) are trisodium phosphate, disodium phosphate, monosodium phosphate and sodium metaphosphate. Of the first three the monophosphate is the most concentrated form (contains the most PO_4 per pound) followed by disodium and trisodium in that order.

It is not ordinarily economical to use phosphates for *pretreatment* of very hard water, but water that has been previously softened with lime and soda

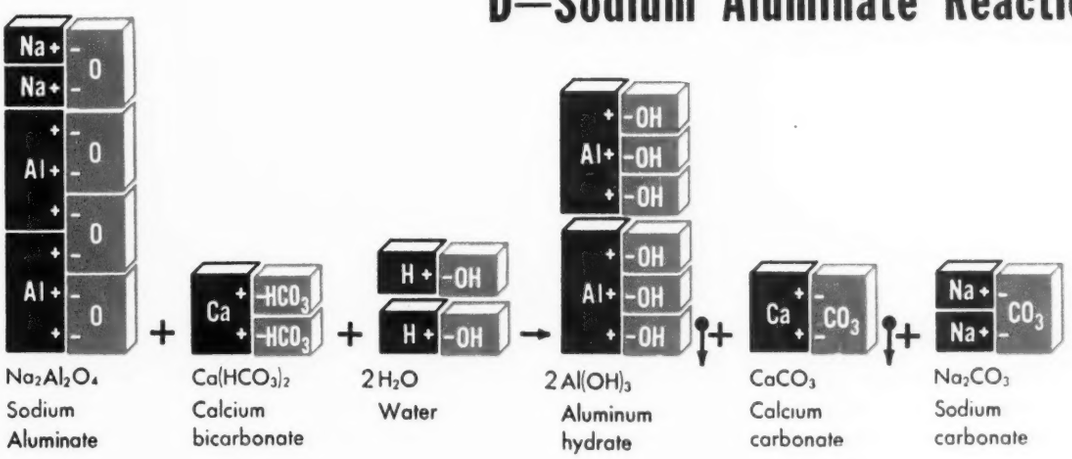


C4



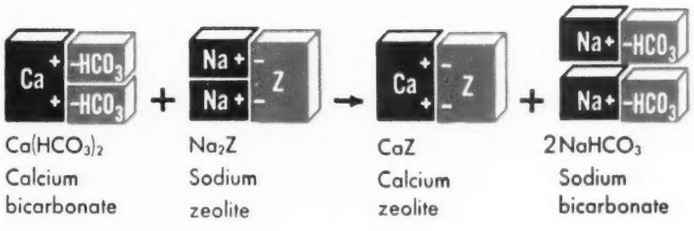
C5

D—Sodium Aluminate Reaction

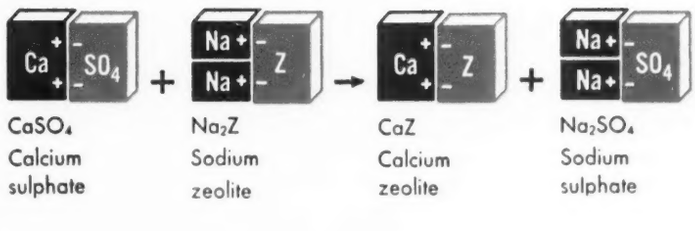


D1

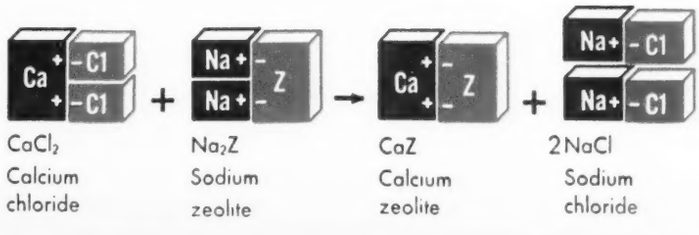
E—Sodium Zeolite Reactions



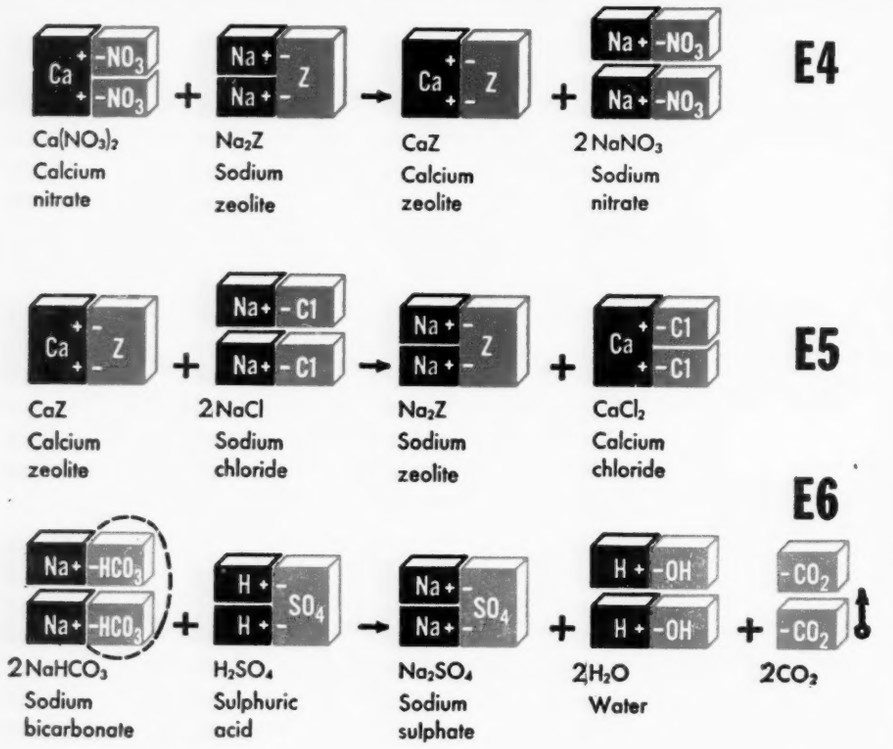
E1



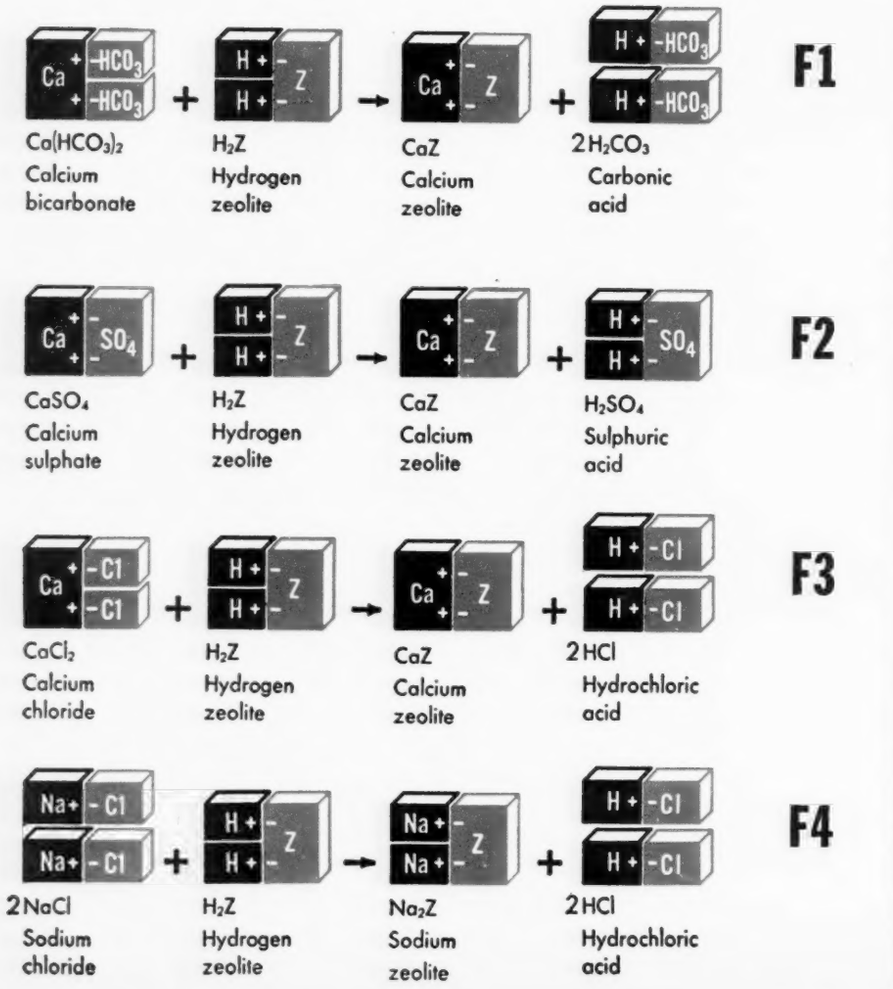
E2



E3



F—Hydrogen Zeolite Reactions



can be made still softer by secondary phosphate treatment outside or inside the boiler.

Sodium Aluminate

One of the many uses of sodium aluminate is illustrated in *D*. This compound is generally used as a coagulant. Here it reacts first with calcium bicarbonate to throw out of solution calcium carbonate and a jelly-like precipitate of aluminum hydrate. Then the aluminum hydrate tends to envelope the particles of calcium carbonate and suspended impurities, making a floc that is easily settled and removed from the water in treating tanks or from the boiler water by blowdown.

Zeolite Softening

For years waters have been softened to commercial "zero hardness" with so-called "zeolite"—natural or artificial substances that look like sand, are insoluble and have the property of exchanging sodium for the calcium and magnesium in hard water. The zeolite is in a tank resembling a pressure sand filter. The hard water passing between the grains gives up its calcium or magnesium to the zeolite, and in turn takes sodium out of the zeolite.

Equations *E1* to *E4* show the softening reactions for calcium compounds. Those for magnesium are not shown, but are exactly parallel. In each case, the softened water contains a sodium salt carrying the acid radical originally attached to the calcium or magnesium of the hard water. Whether the sodium compounds introduced by the treatment are or are not injurious depends on conditions.

Note that *Z* in these equations is not an element, but a complex grouping of atoms, acting as a unit in the zeolite.

The sodium bicarbonate produced in reaction *E1* is broken down by heat to the carbonate and CO_2 gas. This reaction starts in the feed heater and is completed in the boiler. To prevent caustic embrittlement, the ASME code requires certain ratios of sulphate to carbonate in the boiler water, the ratio increasing with the pressure. The actual ratio in the water softened by zeolite will depend on the relative amounts of sulphate hardness and carbonate hardness in the raw water. When the carbonate is too high proportionally it may be necessary to increase the sodium sulphate or decrease the carbonate, or both, by other means —for example, by a subsequent feed of sulphuric acid (See *E6*).

After the zeolite bed has removed a certain total poundage of hardness it

becomes exhausted and must be regenerated (*E5*) by washing with a strong brine of common salt (sodium chloride). This reverses the softening process, pushing sodium back into the zeolite and taking the calcium and magnesium out of the exhausted zeolite. The calcium and magnesium are washed away with the rinse water.

In recent years new synthetic carbonaceous exchangers of remarkable properties have been produced by treating lignite or coal with strong acids. When regenerated with sodium chloride these exchangers operate as sodium zeolites and will remove calcium and magnesium hardness in the manner already indicated in equations *E1* to *E4*.

Unlike the earlier zeolites, these new carbonaceous exchangers can also be regenerated with acid. The acid-regenerated zeolite removes not only hardness but sodium as well. Moreover it can get rid of the bicarbonate radical also. By aeration the carbonic acid produced in *F1* can be split into water and CO_2 and the gas removed. If the water contained no impurity except calcium, magnesium or sodium bicarbonates, treatment with acid zeolite plus deaeration would be practically equivalent to distillation.

In the case of the calcium sulphate and chloride (*F2* and *F3*) only the hardness is removed. The treatment then leaves in the water sulphuric and hydrochloric acid, respectively, which must be neutralized.

In certain cases part of the water is treated with sodium zeolite and part with hydrogen zeolite. If the proportions are properly adjusted, and the two treated waters mixed, the excess acid in one will neutralize the excess carbonate alkalinity in the other.

Equation *F4* shows how the sodium cation is removed from water by hydrogen zeolite.

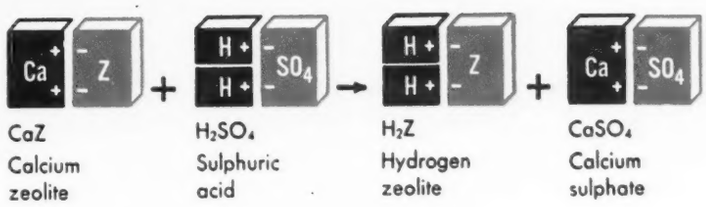
Equation *F5* pictures the regeneration of hydrogen zeolite with sulphuric acid. Other acids may be used.

Breaking Carbonates by Heat

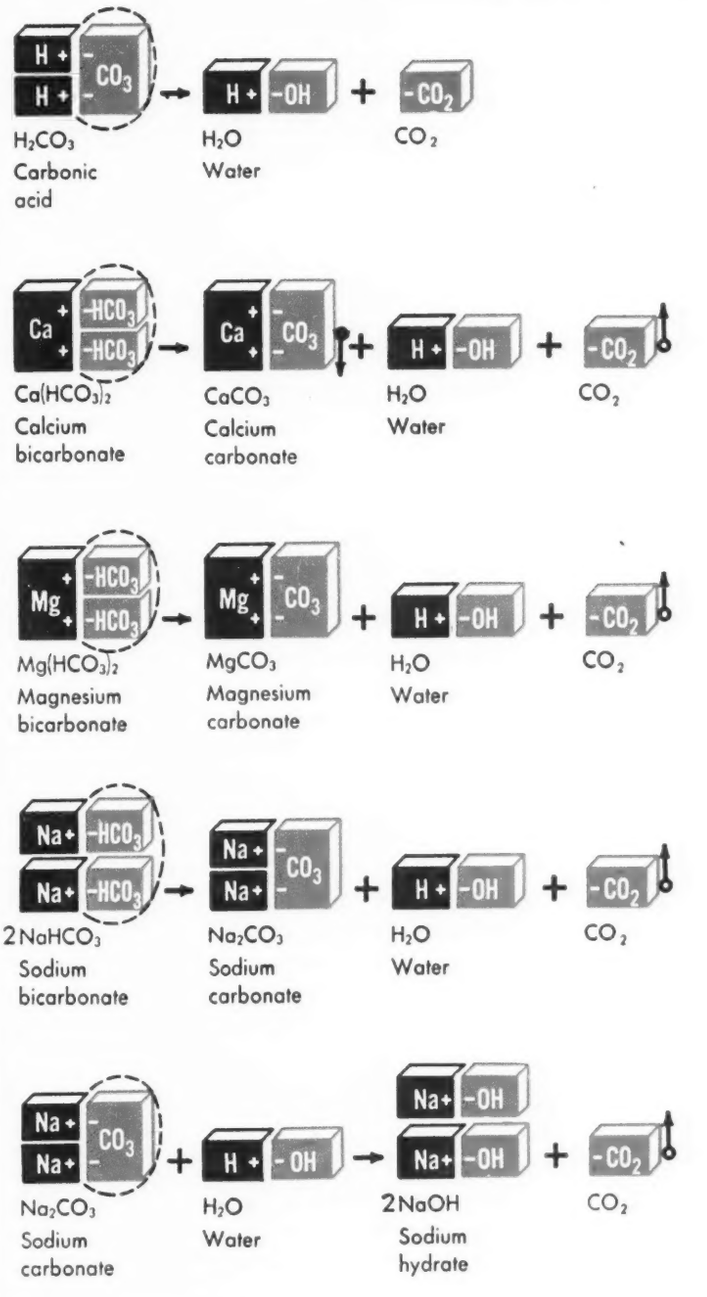
The reactions illustrated in *G* all involve carbonates or bicarbonates plus heat. In every case shown the bicarbonate or the carbonate radical is shattered by the heat, whereupon the atoms assume completely new combinations. In every case CO_2 gas is one of the products. This normally bubbles out of the water and escapes.

The ion-block system which has conveniently represented reactions up to this point is here admittedly inadequate to show what happens. However, the end results are correctly pictured. Briefly, these show that heat breaks carbonic acid (*G1*) into CO_2 and water, breaks down the bicarbonates of calcium, magnesium and sodium (*G2, G3, G4*) into their carbonates (in each case with the evolution of CO_2). The dotted circles indicate that the enclosed radicals are shattered, and do not pass over intact.

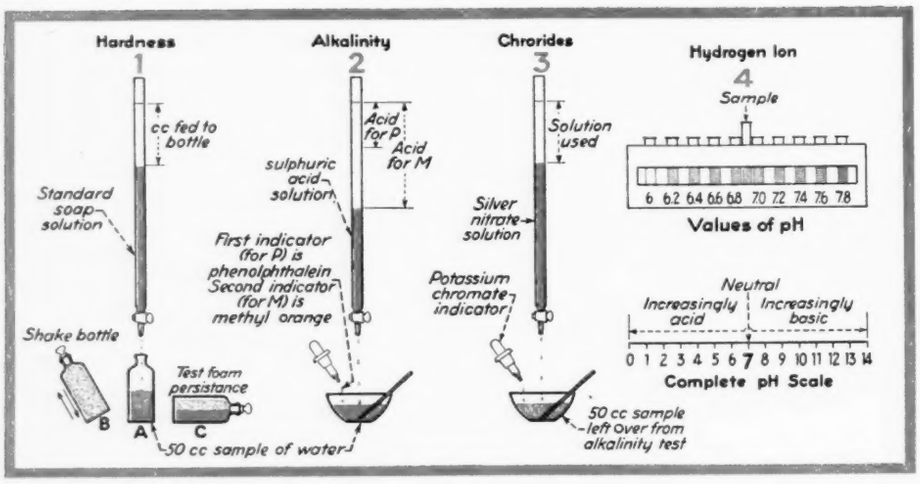
The breaking down of sodium carbonate (*G5*) into hydrate and CO_2 takes place only at the water temperature in boilers operating at moderate or high pressures. The higher the water temperature the greater the percentage of breakdown to the hydrate. Concentration of this sodium hydrate in boiler seams is believed to be a prime cause of embrittlement of boiler metal.



G—Breakdown of Carbonates by Heat



EVERY-DAY CONTROL TESTS



COMPLETE WATER ANALYSIS is a job for the experienced chemist. Fortunately, the day-by-day control of water treatment does not require complete analysis. Any shift engineer or helper can learn to make the simple routine tests for hardness, alkalinity, chlorides and pH. The results will generally show whether treatment is correct, and, if not, what changes must be made in chemical quantities, blowdown, etc. Before starting to make actual tests the engineer should study the detailed instructions furnished with the test kits (see "How to Use the Test Kit," POWER, Feb. 1940, p 109).

The reagents used are ordered ready-made to the indicated strength from the chemical supply house. In tests 1, 2 and 3, size of samples and strength of solutions are adjusted to give all results in parts per million (ppm).

1—Hardness

Fill burette with standard soap solution (1 cc equals 1 milligram of calcium carbonate). Add standard soap solution to 50-cc sample of water in a shaking bottle until lather formed is permanent (lasts 5 minutes). Subtract lather factor (usually 0.3 cc) from total soap solution used, to get net soap used. Multiply net soap by 20 to get hardness, expressed as ppm of calcium carbonate. (See "How to Test For Hardness," POWER, March 1940).

2—Alkalinity

Fill burette with N/50 (fiftieth normal) sulphuric acid. Add 4 or 5 drops of phenolpthalein indicator to 50-cc sample of water. If water turns red, add the N/50 acid (stirring) until color just disappears. Read burette. Then add 4 drops of methyl-orange indicator to give yellow color. Continue adding acid (stirring) until color just changes to reddish orange. Acid used up to the first point × 20 is *P alkalinity* in ppm. Total acid used up to second point × 20 is *M alkalinity* in ppm. These are often abbreviated to *P* and *M*. (See "How to Test for Alkalinity," POWER, April 1940, p 109).

3—Chlorides

Fill burette with silver nitrate solution (strength, 1 cc equals 1 milligram of chlorine). Take the sample left over from alkalinity test. Color it yellow with 5 drops of potassium-chromate indicator. Add silver-nitrate solution (stirring) until sample just changes to an orange. Subtract 0.2 from cc of silver nitrate used. Then multiply by 20 to get ppm of chloride present. (See "How to Test for Chlorides," POWER, May, 1940, p 110).

4—Hydrogen-Ion

Hydrogen-ion concentration, expressed as a pH value, is explained elsewhere on this page. pH may be measured in various ways. Fig. 4 shows a simple form of "comparator". A few drops of some suitable indicator (the particular indicator to be used will be supplied with the test kit or specified in the instructions) is added to a sample of water in a test tube. The color produced depends on the pH.

The short tubes shown in fixed positions in the block contain liquid graduated in tint from the left end of the block to the right, each tint representing the indicated pH value. The sample tube is shifted around until its tint falls between that of the tubes on either side. The pH value of the sample then falls between the values of the two adjacent standards (in this case, between 6.8 and 7.0).

For processes where close pH control is important, or where the color test is impractical, electrical measuring instruments of high precision are available.

Interpreting the Tests

Tests 1 and 2 give the following information directly in ppm:

Test 1—H—Hardness, expressed as calcium carbonate

Test 2—P—Phenolpthalein alkalinity, as calcium carbonate

Test 2—M—Methyl-orange alkalinity, as calcium carbonate

WHAT pH MEANS

The "pH" value of a solution is a convenient measure of its acidity. A neutral solution is represented by a pH of 7. Any pH less than 7 represents a solution that is on the acid side—the smaller the pH the more acid. Any pH larger than 7 represents a solution on the basic side (a base is the opposite of an acid). Very slight changes in pH number represent big changes in acidity. A pH of 5 represents 10 times as much acidity as a pH of 6. A pH of 4 represents 100 times as much acidity as 6. Similarly, a solution with a pH of 9 is 10 times as basic as one with a pH of 8.

The following comments will give a clearer mental picture of the real meaning of pH. Suppose the pH of a certain solution is 9. Write a fraction whose numerator is 1 and whose denominator is 1 followed by nine zeros. That fraction will represent the weight of hydrogen ions in grams in one liter of the given solution. Each liter of the solution, therefore, will contain 1/1,000,000,000 gram (one billionth of a gram) of hydrogen ions.

Now hydrogen ions tend to give a solution an acid character, but there are always OH ions in the solution and these tend to give the solution a basic character. At a pH value of 7 the solution contains one OH ion for every H ion, so the acid effect of the H ions just balances the basic effect of the OH ions, thus leaving the solution neutral (neither acid nor basic).

The first step in the interpretation of these test results is to compare the value of P with that of M. Look for the corresponding condition in the Column 1 of the attached table. Next note how M compares in size with H and locate the proper line in the Column 2 of the table. Reading across horizontally, one finds simple rules for figuring hydrate, etc. All answers come out in ppm.

No such general rules apply to interpretation of pH tests. In practice, the operator usually maintains the boiler water between assigned pH limits, both well on the basic side.

SITUATION	WHEN		THEN RELATIONS BELOW SHOULD HOLD					
	1 *P Equals*	2 *H Equals*	*Free Caustic (OH) is*	*Carbonates (CO_3) are*	*Total Bicarbonates (HCO_3) are*	*Sodium Bicarbonate ($NaHCO_3$) is*	*Permanent Hardness is*	*Temporary Hardness is*
1	0	0	0	0	M	M	0	0
2	0	Less than M	0	0	M	M-H	0	H
3	0	M	0	0	M	0	0	H
4	0	More than M	0	0	M	0	H-M	M
5	Less than ½ M	0	0	2P	M-2P	M-2P	0	0
6	Less than ½ M	Less than M-2P	0	2P	M-2P	M-2P-H	0	H
7	Less than ½ M	M-2P	0	2P	M-2P	0	0	H
8	½ M	.....	0	2P	0	0	0	0
9	More than ½ M	.....	2P-M	2 x (M-P)	0	0	0	0
10	M	.....	M	0	0	0	H	0

THE MEANING OF WATER ANALYSIS

No NON-CHEMIST could be blamed for assuming that water contained 210 ppm of calcium sulphate and 72 ppm of sodium chloride if the analysis were so reported by a responsible chemist. Yet this reasonable assumption would have no basis in fact. Where a number of different compounds are dissolved in water it is impossible to determine by chemical analysis the amounts of each *compound.* A water analysis purporting to show the quantities of various compounds in solution is not a statement of chemical fact, but rather of certain "legal fictions."

It would be wrong to assume from the foregoing that a chemist cannot determine dissolved *constituents* of water. He can, very closely; but not as compounds. Where several compounds are dissolved in the same water, each breaks up into its respective ions. The chemical analysis measures the weight of each kind of *ion* in the solution, but cannot generally determine precisely how they were combined before dissolving or will be after evaporation. In other words, the chemical analysis does nothing but determine the weights of the various "cations" and the "anions" pictured on page 75.

Since analysis determines only the ions, never the compounds, it is logical to report analyses in the ionic form as illustrated by the accompanying table, with no attempt to indicate the "hypothetical compounds." Where analyses do report the compounds assumed to be present, these are figured out by the chemist from the ionic analysis on the basis of certain arbitrary assumptions.

The "combined-form" analysis might be described as a rule-of-thumb attempt to put the analysis in convenient shape for practical interpretation by the man who must control the feed treatment. At least equal convenience, without doing violence to scientific principles, is attained by putting the analysis in ionic form and adding a column of equivalent parts per million *(epm)* as shown. To get the *epm* divide the ppm by the "equivalent weight" of the given radical or substance as listed on page 86.

IONIC ANALYSIS WITH EQUIVALENTS

	PPM	EPM	50 X EPM
Calcium (Ca)....	62	3.10	155
Magnesium (Mg).	31	2.54	127
Sodium (Na).....	38	1.64	82
Iron oxide and alumina	4	0.22	11
Silica (SiO_2).....	18	0.60	30
Bicarbonate (HCO_3)	250	4.10	820
Sulphate (SO_4)...	138	2.87	143.5
Chloride (Cl)....	11	0.31	15.5
Volatile and organic	56	...	...
Total solids by evaporation ..	480	...	...
Suspended matter.	238	...	...
CO_2 free.....	16	0.73	...

Equivalent Weight

This "equivalent weight" is that which contains, or will "match up with," one gram of hydrogen. For example, the molecular weight of sulphuric acid (H_2SO_4) is 98. Since 98 grams of sulphuric acid contain 2 grams of hydrogen, it will require 49 grams of H_2SO_4 to carry one gram of hydrogen. Thus the equivalent weight of H_2SO_4 is 49.

The weights of certain elements, radicals and compounds are frequently reported in terms of calcium-carbonate equivalents, meaning 50 × epm.

The following rules, based on those in "Feedwater Chemistry" by Cochrane Corp, give a practical interpretation of an ionic analysis:

Add the epm of calcium and the epm of magnesium to get A

Add the epm of bicarbonate and the epm of carbonate to get B

Rule 1—If *A* is greater than *B* it indicates permanent hardness proportional to the excess.

Rule 2—If *A* equals *B* it indicates that all the hardness is temporary, with no excess sodium carbonate. This water will produce a carbonate scale which will be more easily removed than if the water contained some permanent hardness.

Rule 3—If *A* is less than *B* it indicates an excess of sodium carbonate proportional to the difference. Such a water commonly produces sludge and not boiler scale.

Rule 4—If the analysis shows any hydrogen radical it generally indicates the presence of free acid or acid properties.

Rule 5—Total hardness, expressed as calcium carbonate, is merely *A* times 50.

If the foregoing rules are applied to the analysis shown, we get $A = 5.64$ and $B = 4.1$, indicating that the water contains moderate permanent hardness.

Lime and Soda Ash Requirements

For lime-soda treatment in hot-process softeners:

Lb of lime required per million lb of water = (epm HCO_3 + epm Mg) × equivalent weight lime

(Equivalent weight of 90% calcium hydrate is 41.1)

Lb of soda ash required per million lb of water = (epm Ca + epm Mg + 0.47 − epm HCO_3) × equivalent weight soda ash (soda ash is taken as pure sodium carbonate with an equivalent weight of 53.3).

USEFUL CHEMICAL DATA

(Reprinted by permission from "Feed Water Chemistry"—Cochrane Corp.)

Substance	*Formula*	*Weight of molecule or radical*	*Equivalent weight*
Aluminum	Al	27.0	9.00
Aluminum hydrate	$Al(OH)_3$	78.0	26.00
Alumina	Al_2O_3	102.0	17.00
Sodium aluminate	$Na_2Al_2O_4$	164.0	27.33
Barium	Ba	137.4	68.70
Barium carbonate	$BaCO_3$	197.4	98.70
Barium chloride	$BaCl_2 \cdot 2H_2O$	244.3	122.15
Barium sulphate	$BaSO_4$	233.4	116.70
Calcium	Ca	40.1	20.05
Calcium bicarbonate	$Ca(HCO_3)_2$	162.1	81.05
Calcium carbonate	$CaCO_3$	100.1	50.05
Calcium chloride	$CaCl_2$	111.0	55.50
Calcium hydrate (pure)	$Ca(OH)_2$	74.1	37.05
Calcium hydrate (90%)	$Ca(OH)_2$	.....	41.10
Calcium oxide (pure)	CaO	56.1	28.05
Calcium oxide (90%)	CaO	.....	31.17
Calcium sulphate (anhydrous)	$CaSO_4$	136.2	68.08
Calcium sulphate (gypsum)	$CaSO_4 \cdot 2H_2O$	172.2	86.1
Calcium nitrate	$Ca(NO_3)_2$	164.1	82.05
Calcium phosphate	$Ca_3(PO_4)_2$	310.3	51.71
Iron (ferrous)	Fe″	55.8	28.90
Iron (ferric)	Fe‴	55.8	18.60
Ferric oxide	Fe_2O_3	159.6	26.60
Iron oxide and alumina	R_2O_3	109.0	18.20
Ferrous sulphate (copperas)	$FeSO_4 \cdot 7H_2O$	278 0	139.00
Magnesium	Mg	24.3	12.15
Magnesium oxide	MgO	40.3	20.15
Magnesium bicarbonate	$Mg(HCO_3)_2$	146.3	73.15
Magnesium carbonate	$MgCO_3$	84.3	42.15
Magnesium chloride	$MgCl_2$	95.2	47.60
Magnesium hydrate	$Mg(OH)_2$	58.3	29.15
Magnesium nitrate	$Mg(NO_3)_2$	148.3	74.15
Magnesium phosphate	$Mg_3(PO_4)_2$	263.0	43.83
Magnesium sulphate	$MgSO_4$	120.4	60.20
Manganese chloride (ous)	$MnCl_2$	125.9	62.95
Manganese hydrate (ous)	$Mn(OH)_2$	89.0	44.50
Potassium	K	39.1	39.10

Substance	*Formula*	*Weight of molecule or radical*	*Equipment weight*
Potassium iodide	KI	166.0	166.0
Silver chloride	AgCl	143.3	143.30
Silver nitrate	$AgNO_3$	169.9	169.90
Silica	SiO_2	60.1	30.05
Sodium	Na	23.0	23.00
Sodium bicarbonate	$NaHCO_3$	84.0	84.00
Sodium carbonate	Na_2CO_3	106.0	53.00
Sodium chloride	NaCl	58.5	58.50
Sodium hydrate	NaOH	40.0	40.00
Sodium nitrate	$NaNO_3$	85.0	85.00
Sodium sulphate	Na_2SO_4	142.0	71.00
Sodium thiosulphate	$Na_2S_2O_3$	158.1	79.5
Sodium tetrathionate	$Na_2S_4O_6$	270.2	135.10
Uranyl acetate	$UO_2(C_2H_3O_2)_2$	388.2	194.10
Uranyl phosphate	UO_2HPO_4	366.2	122.06

ACID RADICALS

Bicarbonate	HCO_3	61.0	61.00
Carbonate	CO_3	60.0	30.00
Carbon dioxide	CO_2	44.0	22.00
Chloride	Cl	35.46	35.46
Iodide	I	126.9	126.90
Nitrate	NO_3	62.0	62.00
Hydrate	OH	17.0	17.00
Phosphate	PO_4	95.0	31.66
Phosphorous oxide	P_2O_5	142.0	23.67
Sulphate	SO_4	96.06	48.03

ACIDS

Hydrogen	H	1.0	1.00
Acetic acid	$HC_2H_3O_2$	60.0	60.00
Carbonic acid	H_2CO_3	62.0	31.00
Hydrochloric acid	HCl	36.46	36.46
Phosphoric acid	H_3PO_4	98.0	32.67
Sulphuric acid	H_2SO_4	98.1	49.05
Manganous acid	H_2MnO_3	104.9	52.45

ALUMS AND PHOSPHATES

Substance	*Formula*	*Weight of molecule or radical*	*Equivalent weight*
Aluminum sulphate (crystal)	$Al_2(SO_4)_3 \cdot 18H_2O$	666.4	111.06
Aluminum sulphate (anhydrous)	$Al_2(SO_4)_3$	342.1	57.01
Ammonium alum	$Al_2(SO_4)_3(NH_4)_2SO_4 \cdot 24H_2O$	906.6	151.10
Potassium alum	$Al_2(SO_4)_3K_2SO_4 \cdot 24H_2O$	948.8	158.13
Trisodium phosphate	$Na_3PO_4 \cdot 12H_2O$ (18.7% P_2O_5)	380.2	126.73
Trisodium phosphate (anhydrous)	Na_3PO_4 (43.3% P_2O_5)	164.0	54.66
Disodium phosphate	$Na_2HPO_4 \cdot 12H_2O$ (19.8% P_2O_5)	358.2	119.40
Disodium phosphate (anhydrous)	Na_2HPO_4 (50.0% P_2O_5)	142.0	47.33
Monosodium phosphate	$NaH_2PO_4 \cdot H_2O$ (51.4% P_2O_5)	138.1	46.03
Monosodium phosphate (anhydrous)	NaH_2PO_4 (59.1% P_2O_5)	120.1	40.03
Metaphosphate (Hagan)	$NaPO_3$ (69.5% P_2O_5)	102.0	34.00

Long War or Short? Take Your Choice---

This war may easily drag along for another five years, if we let it—yet America has the power to force the defeat of the Axis powers before the end of 1943. The choice between two more years of war and five is straight up to us—meaning our government, our business and industrial leaders, our labor leaders, our engineers, our skilled mechanics and unskilled laborers, our housewives and other consumers. If they all say yes, and mean it, we can have this business behind us in two years.

Already the men of government and the business men who have gone to Washington to help out are rolling up their sleeves for a high-pressure program. All that stands in the way is the fact that the average citizen still doesn't understand how critically the international situation endangers his prosperity and his way of life—how that danger, and the cost to him of avoiding it, increases with the length of the war—how he can cut three years off this war by merely willing to do so.

The estimate of five more years of war is based on our present program, which will gradually surpass Hitler in one line of production after another and eventually (say by 1946) give the anti-Axis combination enough margin of power to win. Note that this margin must be in actual *accumulated war goods* (planes, tanks, rifles, cannon, battleships, merchant ships, etc) not merely in *rate of production* of these items.

Note also that it takes a long time to pile up a big lead if the other fellow has a head start and is moving almost as fast as you are. That's why the pace of our present defense program would probably mean five more long years of killing abroad and murder on the high seas—five more years of disorganization of our normal lives and normal economy in this country.

The bright spot in this picture is the known fact that we can run a lot faster than the other fellow if we put our heart into the effort. America's stupendous productive capacity is a matter of record. We can put much of it to work for defense if we want to. We can cut that five years to two if we really mean business—if we are ready to dump overboard every non-essential civilian activity that ties up machines, men or materials that could be used in defense production. If we hit this pace for two years it will cost us less in pains and money and post-war readjustment than if we roll "comfortably" along for another five with a moderate defense effort.

And don't forget that the slower we work at this defense job the more time Hitler will have to harness to his chariot the slave power of captive Europe.

When the average citizen clearly sees these alternatives he will choose all-out production and a short war. The government is ready to move in that direction at once—and so are the business men who have gone to Washington to help their country meet this emergency. They will go as far and as fast as public sentiment will permit.

The engineer who has read so far, and grants that it would be plain common sense to compress our defense activities into two years, will ask what he can do toward that end. Here are our suggestions:

1. Even where they hurt your local or personal interests, support all government efforts to cut the non-essential uses of aluminum, copper, brass, nickel, steel and other scarce and vital defense materials.

2. In your own plant promote thrift and ingenuity in replacing essential materials by non-essential and in getting along with less of the essential where they cannot be replaced.

3. Frown on waste of material, of man hours, of machine hours, of motions.

4. Encourage subcontracting to spread the defense load, remembering that thousands of machines (in small plants, particularly) are not doing the defense job they could.

5. Promote efficiency in production, meaning high production per machine hour and per man hour.

6. Promote the large-scale training of skilled and semi-skilled workers and supervisors.

7. *Finally (and this is the most important thing), get more hours per week out of each machine in a defense plant.* Remember that 40 hours is no good and 80 hours is less than fifty per cent utilization efficiency. We forget that there are 168 hours in a week. "Par" for defense machine hours in any plant must represent all machines working 168 hours per week. Today the average plant that claims to be "working day and night" on defense cannot show 50 per cent utilization of its potential machine hours. Even the "three-shift" plants generally run short-handed on the night shifts.

When we Americans really turn our minds and hearts to this job we will amaze the world with the result—turn out defense goods three or four times as fast as any other nation on the face of the earth. So let's get moving!

Phil Swain, Editor

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Winchester Repeating Arms Co.
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Container Corporation
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RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Seattle Baltimore Richmond Denver
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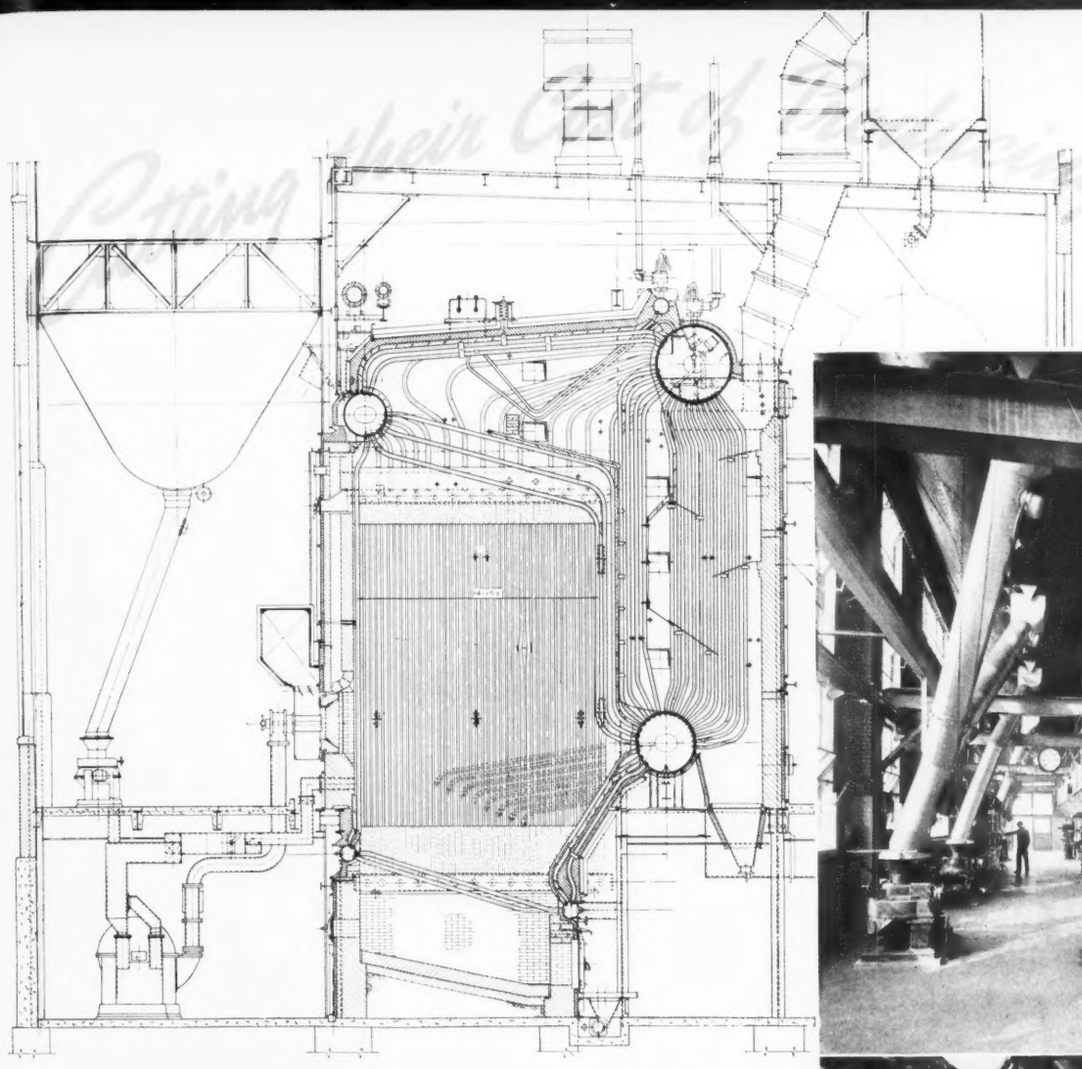
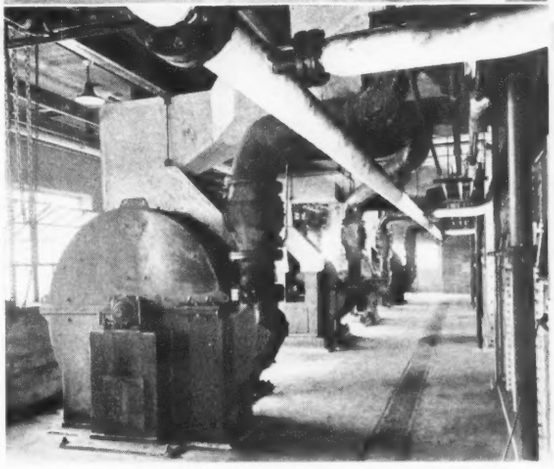
It will pay you to visit modern Riley Installations

. . . . and use this method of





for cutting their cost of producing steam, Henry Disston & Sons, Inc. install RILEY BOILER UNITS

The Henry Disston & Sons, Inc. plant covers 65 acres located on the Delaware River front at Philadelphia. Formerly steam was generated by 23 stoker and hand fired units located in four different boiler plants.

When it was decided after studies by their Consulting Engineers, H. M. Wilson Company, to construct a modern highly efficient centralized boiler plant, 3-85,000 pounds per hour Riley pulverized coal fired steam generating units were selected as the type best suited to cut the cost of producing steam. Performance has indicated the correctness of this choice. The units operate at efficiencies of 83.16% against guarantee of 82.6%; flue gas temperature is 467°F. against guarantee of 480°F.; draft loss is 0.2 inches against 0.33 inches and capacities of over 90,000 lbs. have been easily obtained against guaranteed peak capacity of 85,000 lbs./hr. As is customary, the Riley Unit performs better than guarantees.

Because steam is required at only 125 pounds, 428°F., until such time as it becomes desirable to electrify engine drives, economic studies favored installation of units designed for future operation at 600 pounds and without heat recovery equipment but designed for economical installation of air heaters when going to high pressure operation.

Here is another case where large fuel and labor savings have resulted from the installation of Riley-Boiler Units. You also can undoubtedly make large savings in your plant. Our engineers will gladly consult with you.

HENRY DISSTON & SONS, INC., Philadelphia, Pa.
H. M. Wilson Co., Consulting Engineers

UPPER VIEW—Firing Aisle showing Riley burners and pulverized coal feeders.

LOWER VIEW—Basement showing Riley pulverizers.

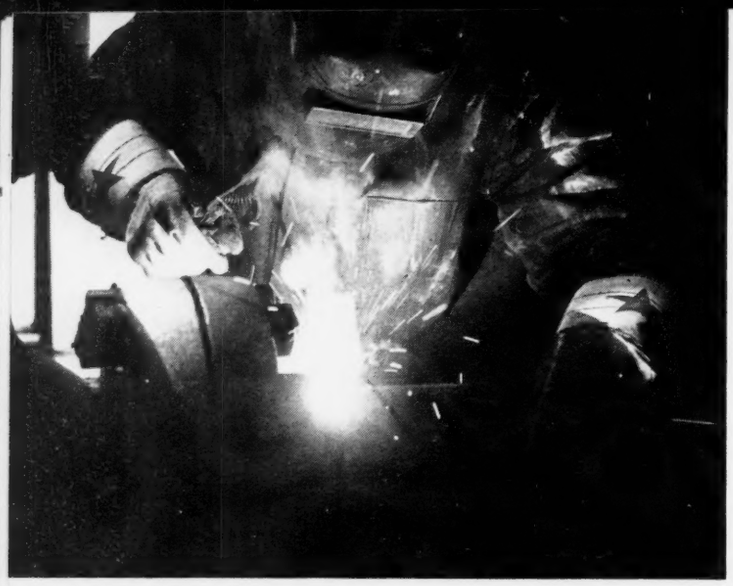
An article describing this new boiler plant appeared in the October issue of POWER. Copies will gladly be sent if requested.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR-HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment



Downhand welding of 8-in. high-pressure pipe to valve flange

Making one of the six passes in arc welding U-groove joint in 8-in. pipe

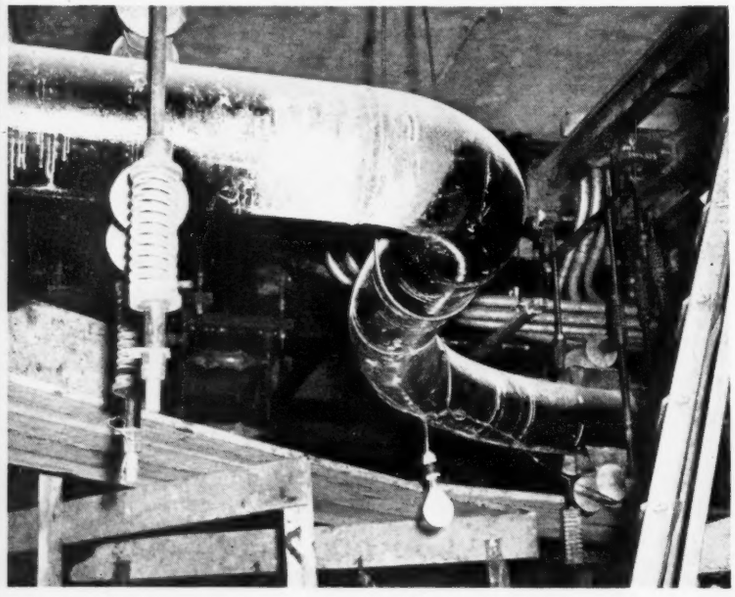
Overhead welding of 8-in. steam pipe

Six Miles of Welded Piping

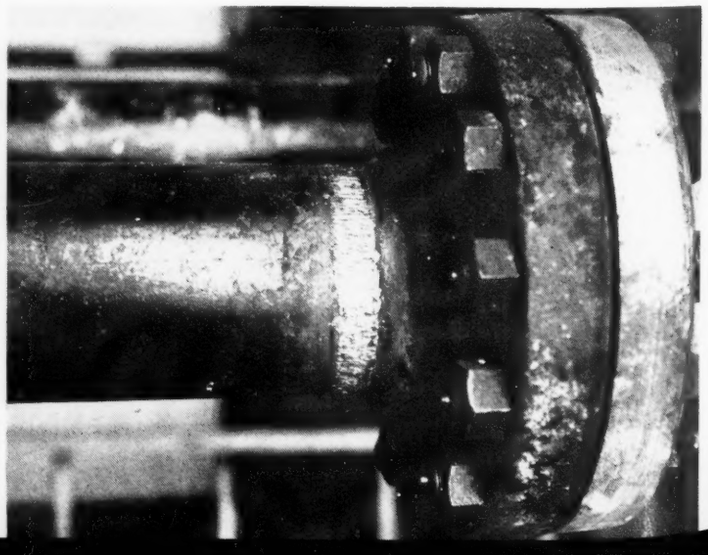
► SIX MILES of electric-arc welded piping will handle steam and water in the latest extension to the municipal power plant at Cleveland, Ohio.

Welded piping ranges in size from $2\frac{1}{2}$ to 16 in. in diameter. Operating temperature is 850 F, pressure 650 lb. Arc-welded construction was specified by the city because of the stronger connections obtainable. Shielded-arc equipment, supplied by The Lincoln Electric Company, was employed.

Four of the photographs show steps in welding 8-in. high-pressure steam line. In these joints, six passes were made with $\frac{3}{16}$-in. "Fleetweld No. 5" electrode. The joint was first tack welded; then the first bead was deposited within the space between pipe ends. On this first bead care was taken to avoid burning through the back-up ring. The joint is U-groove type. For the second bead, current was increased to obtain 100% fusion with the first bead and the back-up ring.



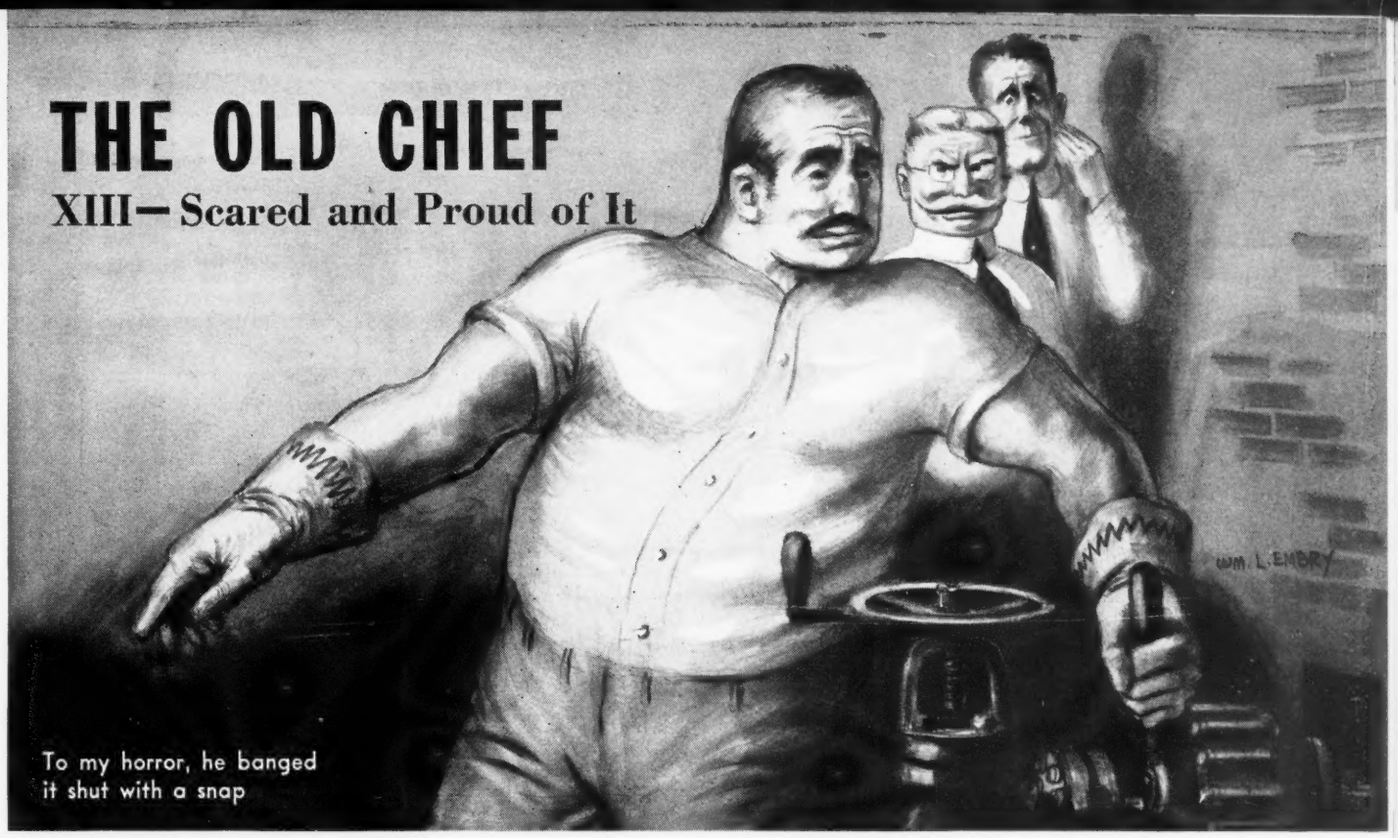
Arc-welded 12-in. boiler-feed line



Finished joint on 8-in. pipe, welded in six passes with 3/16-in. electrode

THE OLD CHIEF

XIII—Scared and Proud of It



To my horror, he banged it shut with a snap

Thirteenth in a series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the past, he has captured much of the human side of engineering

▶ CALL IT SUPERSTITION if you like, but I do believe that Monday has justly earned the title of "blue." Most of the unpleasant things that have happened to me have happened on a Monday. I recall one particularly blue one when the Old Chief and I were at the back of the boilers, examining a soot-blower that was the bane of our lives until we threw it in the scrap heap. While we were there one of the operators came around to blow down one of the other boilers. As he was a man that I had broken in myself and recommended for promotion, I was hopeful that he would do nothing careless in the presence of the Old Chief.

Everything went fine until he came to close the quick-opening valve, then to my horror he banged it shut with a snap as if it were a punch press or a cheese cutter. The Old Chief's neck swelled and he became the hottest thing in that boiler room. In a quiet voice he asked the man how long he had been operating, who had instructed him in the use of that valve, did he know the result of a sudden change in flow velocity, did he know that there were scores of cases on record, where tail pipes had been ruptured and even severed from the boiler by just that kind of boneheaded malpractice? He then proceeded to demonstrate the proper method of closing the valve. "And," he added to me before moving away, "I will thank you to attend me in my office before you go off duty. I will tell you a story that may bring home to you the importance of the subject we have been discussing." Back in the office I was reminded that I had vouched for the man's capability and that I had praised his smartness. I was told that smartness was not appreciated where human lives and valuable property were at stake. I was told that it would be nice if I gave personal instruction to every operator in the proper manner of opening the quick-opening valve first and closing it last.

At three pm, the unfortunate culprit came into the office and the Old Chief re-told the story of the great Midland explosion which took place on the day after Thanksgiving in 1913. He described the plant, which housed five hrt boilers, with walls of rubble stone and corrugated-iron roof. The boilers served a couple of chunky big engines (Goldie McCulloughs), which were the heart of a big-time lumber mill.

Old man Stevens had tended the engine for many a day and now his son had grown up to the point where he was trusted to handle the job on his own. He could skip up and down the catwalk like a monkey. He was busy oiling his job one day and everything was going full steam ahead, when three shrill blasts of a whistle gave the signal to young Stevens that they wanted him to shut down the engine, while they changed the saws. He grabbed the throttle wheel, which was thirty inches in diameter, and gave it a spin. It saved time to do it that way. Of course he always caught it before it reached the last quarter of the yoke and then eased it down slowly.

But this day, because of too oily hands or misjudgment, he failed to catch the wheel. It closed with a bang and the boiler exploded. The other boilers in the battery which were under steam also exploded. The stone walls caved in, burying the mangled bodies of the men under tons of debris. A final sad note in the disaster was the finding of the bodies of two lads who worked in the factory next to the lumber mill; they had slipped into the boiler room for a "shin heat" that cold morning.

Concluding his story, the Old Chief made further reference to the danger attending a sudden change in velocity of high-pressure steam. He handed the man a copy of the Rankine charts and asked him to figure out in his spare time the total energy that would be released and available to produce destruction, in addition to the displacement of the atmosphere, for each pound and each cubic foot of contents at 150 lb gage and a three-quarter glass.

After the man had gone the Old Chief mopped his brow. "I hope," he said, "that he will be scared of pressure vessels for the rest of his life." *I have been scared to heck of them for forty years, and I'm proud to admit it.*

Burlington Charts the Way for Motor-Operated Valves

By S D BARR
Manager, Limitorque Division, Philadelphia Gear Works, Inc

In this station 81 valves are now operating or being installed, ranging from 12 in. for 1250 lb per sq in., 950 F, to 3 in. size on oil lines, that are motor operated and controlled from local pushbutton stations or from panel boards in the pump, turbine and boiler rooms

► BURLINGTON GENERATING STATION of the Public Service Electric and Gas Co, New Jersey, featured in July POWER as the station selected "for design representing stable trend for the future," has one of the largest installations of electric valve operators ever made. This plant has a total capacity of 180,000 kw in 5 units. The last unit installed, rated 125,000 kw, operates at 1250 lb per sq in. and 950 F total temperature. Another similar unit is now being installed.

Electric valve operators were first used by this company in 1916 when they were installed on the main steam header valves of several boilers so that when necessary a boiler could be cut off the line from a remote location. Since that time pressures and temperatures have increased from 250 lb per sq in. at 450 F to 1250 lb at 950 F. These pressure and temperature increases have made it difficult to close large valves manually when required or in an emergency. Motor-operated valves, therefore, have been used in an ever-increasing number to insure positive and rapid emergency control and normal operation.

Operator Applications

It was found expedient to use electric motor operators not only on high-pressure steam lines but also on intermediate- and low-pressure steam, feed-water, pressure-reducing and desuperheating, condenser-circulating-water and fuel-oil lines, until today in the Burlington generating station there are in operation or being installed 81 valves equipped with these operators. These vary in size, as shown by the table, from the 9x10 ft sluice gates on circulating-water intake to 3-in. valves used on the fuel-oil supply lines.

Electric operators consist essentially of a reversing torque motor *M* driving

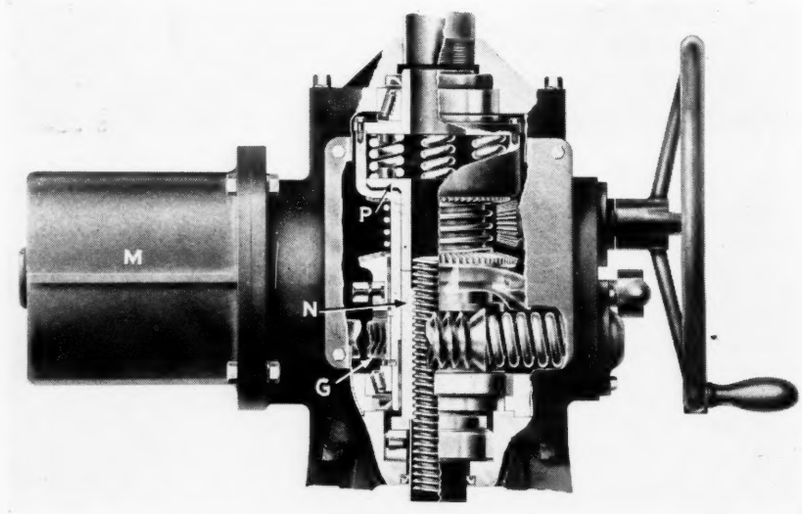


Fig. 1—Electric valve operator seats the valve against a predetermined thrust

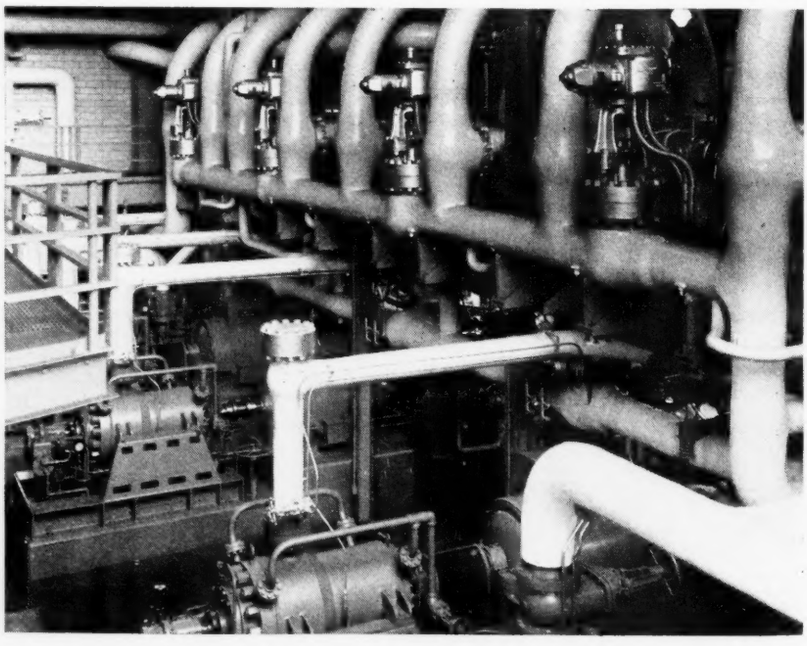


Fig. 2—Burlington boiler-feed-pump and heater room showing four motor-operated 1750-lb-per-sq-in., 10-in. valves on the feed-water header

through a train of accurately cut gears to the stem nut *N* of the valve, Fig. 1. The motor is controlled so that it automatically stops the valve disk at full-open or full-closed position. This control can also be set to stop the valve at any intermediate position of the travel. The gear train consists of a helical pinion on the motor shaft driving a helical gear on the worm shaft. This in turn drives the worm gear *G* which drives the sleeve splined to the stem nut *N*. The stem nut floats against a spring plate *P* which takes care of expansion in the valve stem due to high temperatures and absorbs the kinetic energy of the moving parts. All parts are enclosed in a weather- and water-tight housing filled with a suitable gear lubricant.

The valve is automatically stopped in the open position by a set of geared limit switches which interrupts the control circuit and is brought to full close position by a set of geared limit switches which open as the valve is seating. A set of torque switches, actuated by a thrust applied on the valve stem connected in parallel with the closed limit switches, operates the valve until it is fully seated, whereupon they open, stopping the motor. Indicating lights operate from the geared limit switches. Seating thrust can be varied 200% or more by a micrometer adjustment on the torque switch.

A lost-motion device in the valve-operating unit allows the motor to reach full speed before the unseating load is applied, and provides an effective unseating impact at the valve stem. This impact or hammer blow gives an unseating impact of approximately 10 times the maximum available torque. Due to this hammer blow the motor size and current consumption of these electric operators are very considerably reduced.

Provision is made for manual operation of the valve when desired, by means of a handwheel built into the electric operator. The motor is entirely disconnected from the handwheel drive during manual operation. For safety, this handwheel does not rotate during electrical operation. The operator is always operative electrically without the use of manually operating mechanical or electrical devices, or auxiliaries.

Control stations for the operators are usually of the 3-button, 2-light type. When either the "open" or "close" momentary contact button is depressed the valve will open or close to its full travel unless stopped at any intermediate position by the "stop" button. An open or closed valve is indicated by lighting a red or green light. Intermediate positions are shown by lighting both lights to half brilliance.

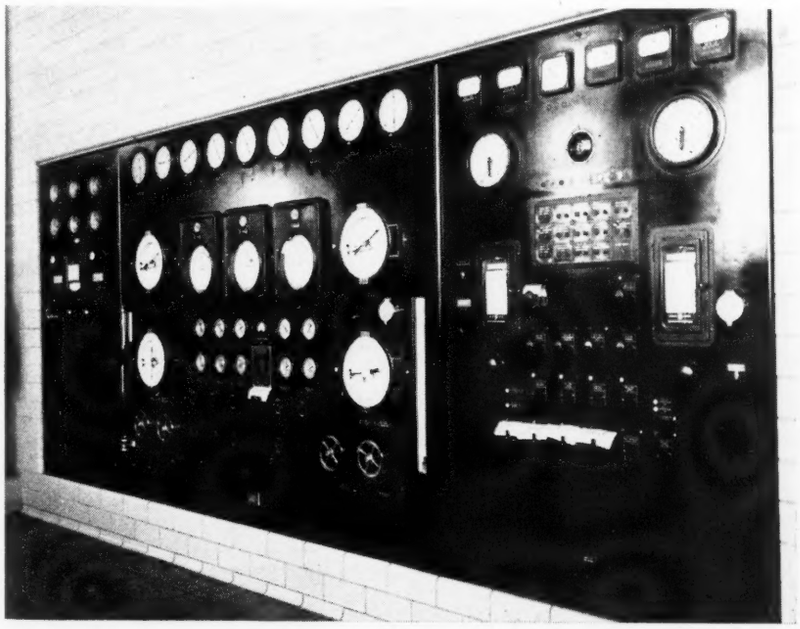


Fig. 3—Turbine control panel where bleeder valves, turbine-stop valves, atmospheric-exhaust valves and main steam valves can be controlled in an emergency; they are normally controlled from local pushbutton stations

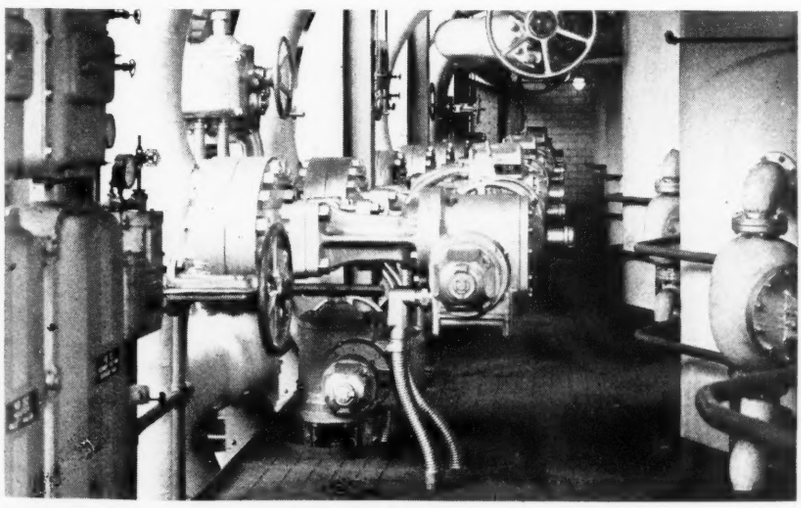


Fig. 4—A group of 1750-lb remote-controlled motor-operated vertical and horizontal feedwater valves with local control station at left

Control Stations

From the list of motor-operated valves it is evident that electric operators no longer serve only in an emergency but are necessary to the normal operation of the station. To facilitate the latter, the controls of these valves are grouped on central panel boards at strategic locations in the station.

In the Burlington generating station all boiler-feedwater and circulating-water valves are controlled from a central pump panel. For normal operation bleeder valves, turbine-stop valves, atmospheric-exhaust valves and main-steam valves are controlled from local pushbutton stations with emergency control on a turbine-control panel, Fig. 3. Typical local pushbutton stations are shown in Figs. 5 and 6. Boiler feedwater-level-regulator valves and fuel-oil valves are controlled from a boiler-room panel. In addition to these panels there is an emergency shut-down board from which the forced-draft fans can be stopped and the king valves on the boilers can be closed simultaneously.

One 9x10 ft and two 7x10 ft sluice gates are operated by an electric control built into a floorstand having a water-tight box cast integral with the pedestal. In this compartment are the reversing controller, the pushbutton station with red and green indicating lights completely wired and forming a weather-

MOTOR-OPERATED VALVES AND THEIR SERVICES

Burlington Station, Units No. 5 and No. 6

Steam Valves				*Boiler-Feedwater Valves*			
No. of valves	*Size, in.*	*Pressure lb. per sq. in.*	*Service*	*No. of valves*	*Size, in.*	*Pressure lb. per sq. in.*	*Service*
4	12	1250	Steam header	8	10	1750	Heater inlet
4	12	1250	Cross-over line	8	10	1750	Heater bypass
				8	10	1750	Heater outlet
4	12	1250	Turbine stop	1	10	1750	F-W header
				1	10	1750	Hot-water cross over
2	12	1250	Main reducing stop	7	6	1750	F-P discharge
2	4	1250	Auxiliary reducing stop	1	6	1750	Cold-water cross over
1	12x20	1250	Main reducing				
1	14	650	Reducing stop	4	8	1750	Level regulator inlet stop
1	16	650	Steam header				
1	24	200	Cross-over exhaust	*Circulating-water valves*			
2	24	200	Turbine exhaust	4	48		Condenser inlet
1	20	200	Reducing stop				
1	18	200	Low-pressure turbine stop	2	7x10 ft.		Sluice gate
1	18	200	Header tie	1	9x10 ft.		Sluice gate
2	14	200	Bleeder	2	25x36 in.		Condenser inlet water boxes
1	8	200	Atmospheric exhaust	*Fuel-oil lines*			
1	6	200	F-P turbine throttle	5	3		Fuel-oil supply stop

proof operating unit for outdoor use.

Motors on all operators are of the high-torque, low-starting-current type especially designed for valve operation. They are equipped with ball bearings and provided with grease seals that permit their being mounted in any position. Designed to run at 1800 rpm, the motors normally operate on 125-volts dc but are built to operate over a range of 70 to 140 volts from storage battery supply. The motors deliver their full rated torque at the minimum of 70 volts. In the design of this type of motor, care is taken to keep the kinetic energy (WR^2) of the rotor at a minimum. This is done to prevent the drift of the motor from driving the wedge or disk of the valve too tightly into the seat.

In determining the size of the torque motor needed for each of these valves, it is necessary to convert the stem thrust in pounds required to operate the valve into torque in pound-feet. This is done by multiplying the required stem thrust by the factor K which is obtained from the formula:

$$K = \frac{d}{24}\left(\frac{\pi\ df \text{ plus } L \text{ Secant } \phi}{\pi\ d \text{ minus } Lf \text{ Secant } \phi}\right)$$

Where d equals mean stem-thread diameter in inches; π equals 3.1416; f equals coefficient of friction of stem nut on valve stem; L equals stem lead in inches; and ϕ equals one half the included angle of stem thread (14.5 deg for 29-deg Acme thread). When this stem torque is found it is then worked back through the gear train in the operator to the motor shaft, giving the torque rating of the required motor.

For years the trend in power-plant control has been toward centralization. What has been done at Burlington with motor operated valves is another step toward concentrating control of all operations in large power plants at a few strategic points under the supervision of responsible operators. This installation is an outstanding example of how electric valve operators can be applied and how Public Service Electric and Gas Co's engineers have made a contribution to sound power-plant engineering practice by eliminating manual operation of all important valves.

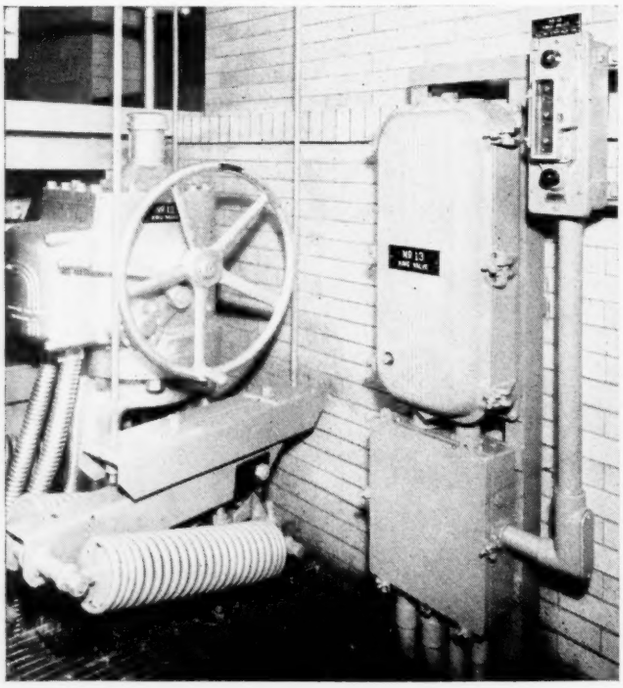


Fig. 5—Remote-controlled motor operator on 1250-lb king valve with local control at right

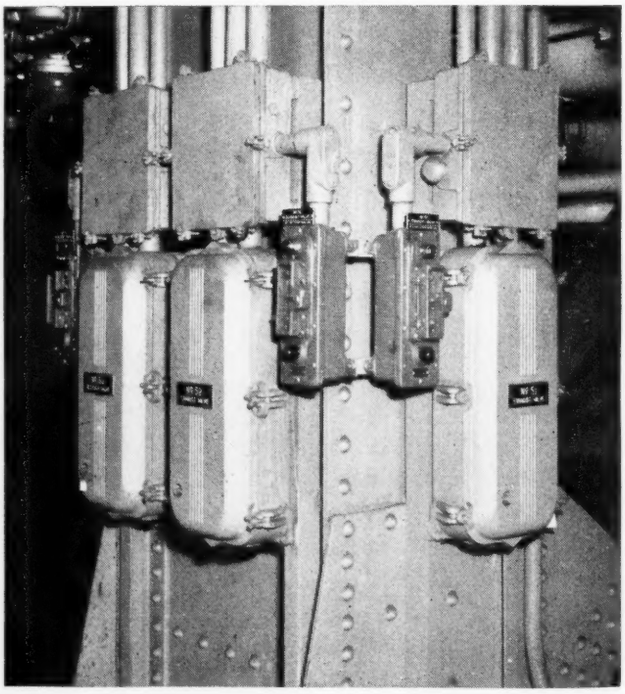


Fig. 6—Group of local control stations and enclosed contactor panels mounted on power-house steel column

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

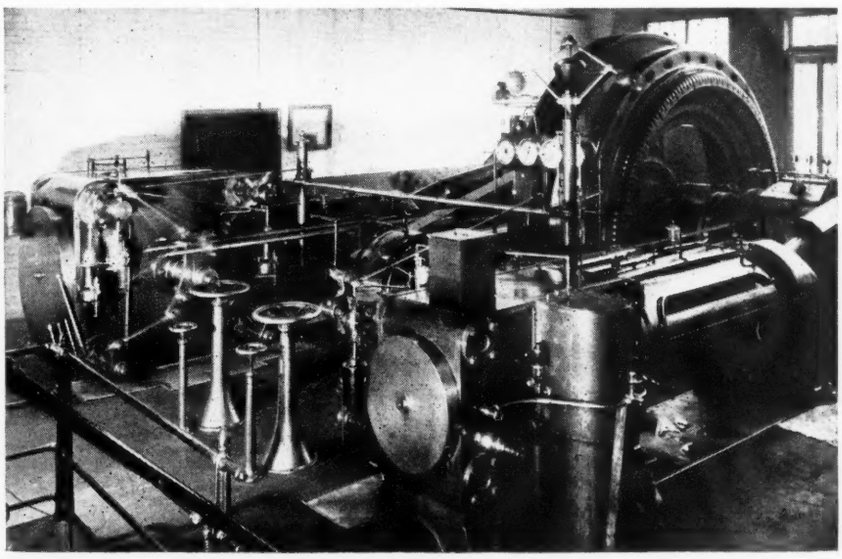
Published monthly as an integral part of POWER

Plant-Designed Woodburning Setup Meets Test of Experience

Sawdust and wood waste gravity-fed from collectors and storage bin; most of sawdust burns in suspension while remainder and wood waste burns on flat grate in boiler furnace at Standard Furniture Co's Herkimer plant

SIMPLIFIED ARRANGEMENTS for burning sawdust and wood waste, worked out by W R Jones, chief engineer, and the boiler manufacturers' representative have produced a needed capacity increase and have eliminated use of coal except on weekends, at the Herkimer, N. Y., plant of Standard Furniture Co. This "plant-designed" unit cost about one-quarter as much as suggested alternative equipment.

With large quantities of kiln-dried waste wood and sawdust to be disposed of, this plant always has burned some waste fuel, but always in combination with coal. There were five McEwen horizontal-tubular boilers; three, of 2250 sq ft, were installed in 1912, the other two, 2000 sq ft each, dated back to 1906 or earlier. Coal and waste wood were handfired into these units and sawdust fed by chutes. Too-low settings caused poor combustion, restricted capacity and made it necessary to burn wood and coal in combination. With this system, there was surplus wood and sawdust to be disposed of; the wood was sold, but not profitably.



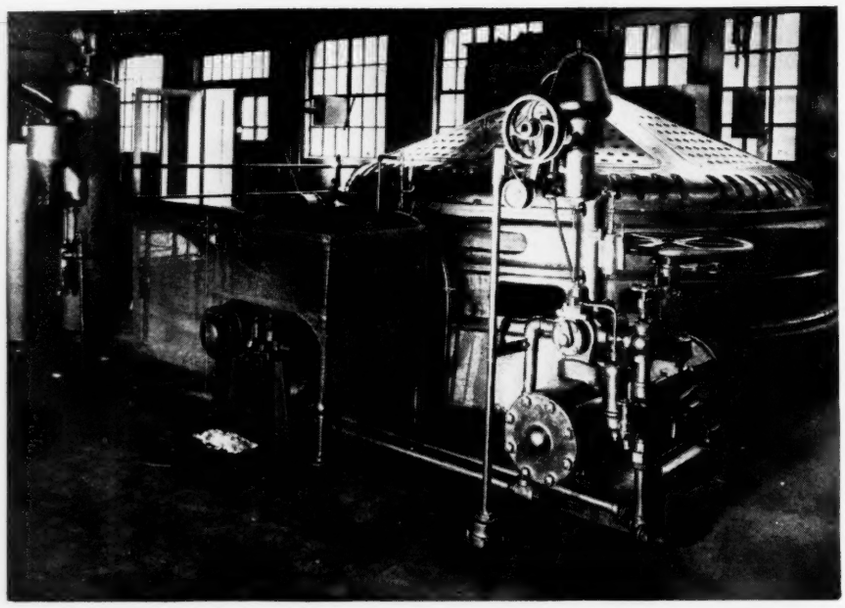
Cross-compound engine, rated at 325 kw, handles major part of plant load

Steam from this boiler plant supplied drying kilns, the forced-circulation hot-water heating system, some unit heaters and glue pots. Major steam supply went to an 18x36x42-in., 325-kw Knowlson & Kelley cross-compound engine generator, equipped with a jet condenser. It would have seemed more economical to operate the engine non-condensing and use the exhaust for process instead of the live steam now used, but apparently this was not considered when the unit was installed in 1906.

Throughout the more than 50 years of the plant's history, water power from West Canada Creek has been utilized; the present plant contains two 150-kw Morgan-Smith turbines installed in 1916. These are operated to use all water available; load swings were, and still are, taken on the steam engine. A connection with the Herkimer municipal plant provides standby. Usually the furniture plant takes all the kwhr available on the standby billing and occasionally loss of waterwheel capacity because of winter ice will require use of more than this amount. Total plant load averages 450 to 500 kw and is quite steady.

Early in 1939 load growth and reduced capacity of the old boilers made it necessary to consider changes in the boiler room. Engineers recommended dismantling the two oldest boilers and installing two new 2500-sq-ft stoker-fired units. These were to burn coal and sawdust during the day and handfired wood waste at night. Surplus wood waste was to be sold as before.

Chief Engineer Jones felt that this



One of two 150-kw water turbines operated to utilize all available stream flow

scheme was unsatisfactory because it was impossible to burn all wood waste during the night when load is light (steam for kilns, mainly) and because his figuring, based on intimate knowledge of the situation, showed that it was not economical to sell wood and buy coal. He wanted a firing arrangement that would eliminate need for coal as far as possible and that would eliminate handfiring of waste wood. And, as usual, these results had to be obtained at minimum cost.

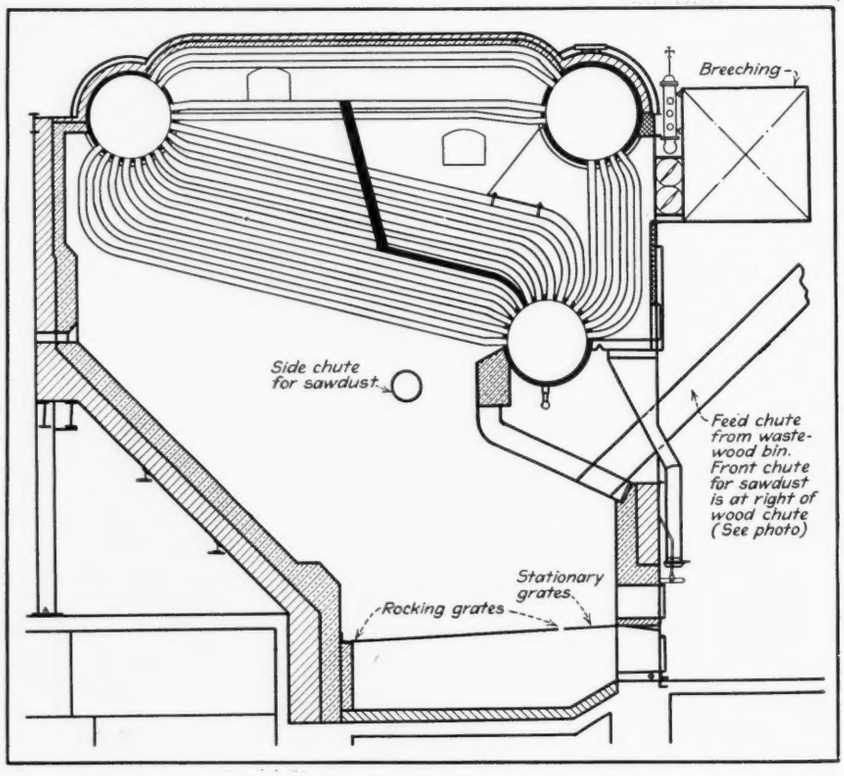
Actually, burning wood waste like that at Standard Furniture is not difficult. All wood is kiln dried and moisture runs about 7%. About half is "hardwood," oak, maple and birch, and about half "softwood," bass, chestnut, poplar, walnut and mahogany. The waste wood comes from the factory in odd pieces running up to about 4x15 in., and contains some veneer scraps as well. Sawdust separates from the conveying air in three cyclones on the boiler-house roof.

With all these conditions in mind, Chief Engineer Jones suggested a single large boiler designed to burn sawdust in suspension as far as possible and for chute feeding of waste wood. The cross-section and photos show the low-cost arrangements to swing this job. The boiler is a 4500-sq-ft, low-head, Union Iron Works unit, with ample furnace volume for proper combustion of wood. Sawdust from two cyclones feeds into the furnace front and from the third cyclone into the side. Chute slopes are such that gravity, aided by the slight residual air pressure from the cyclones, takes care of sawdust flow without "hangups." Compressed-air connections are available in case of feed failure, but are seldom used. Most of the sawdust burns as it falls from the chute openings to the grate; the remainder burns on the grate, which has a short stationary and a long rocking section. Cyclone location made it necessary to connect two units to the front feed chute; it is planned to move this cyclone and install another chute on the left side of the boiler, to equalize the firing.

Waste wood comes from a storage bin on the boiler-house roof through a large chute entering the front of the furnace, where it burns on the grate. A gate controls waste-wood feed and with bin storage available the wood feed can be cut off for as long as a day without trouble. Because sawdust comes direct from the collecting and separating system, without provision for storage, it must be burned as fast as it comes from the factory.

A home-made agitator keeps waste moving in the chute. As shown in the photo on the next page, a ¼-hp motor drives an automobile transmission, which gives three speeds of operation. The shaft inside the chute carries two angle irons, welded on, with saw teeth cut in the edges. An occasional oversize piece will clog the chute, requiring hand cleaning, but, in general, the agitator keeps the material moving satisfactorily.

Need for burning sawdust as fast as it comes from the factory and also for keeping equipment cost to a minimum led to a rather unusual system of control and operation. During the normal working day, the sawdust supply nearly equals the fuel requirements. When it exceeds the steam demand, pressure rises and the safety valves relieve. When falling pressure indicates need for more fuel, the fireman opens the feed gate and admits wood waste to make up the deficiency. Usually no coal is burned day or night during the week and sufficient wood is stored during the day to


Breeching
Side chute for sawdust
Feed chute from waste-wood bin. Front chute for sawdust is at right of wood chute (See photo)
Stationary grates
Rocking grates

Main sawdust and wood-waste chutes enter boiler furnace at front; an additional sawdust chute, from another collector, enters at the side as shown

carry the load at night when the factory shuts down. Weekend loads are carried on stored wood as far as possible, supplemented by coal.

Although this arrangement might seem crude, it must be remembered that the small amounts of steam lost when the safety valves relieve are generated from a waste product that must be disposed of in any event. The true test, two-year's experience, shows this scheme to be adequate for all requirements and it has, of course, the great merit of being simple and inexpensive. It may prove desirable to install a hog and blow surplus wood to an overhead bin for storage against weekend use, cutting out use of coal completely.

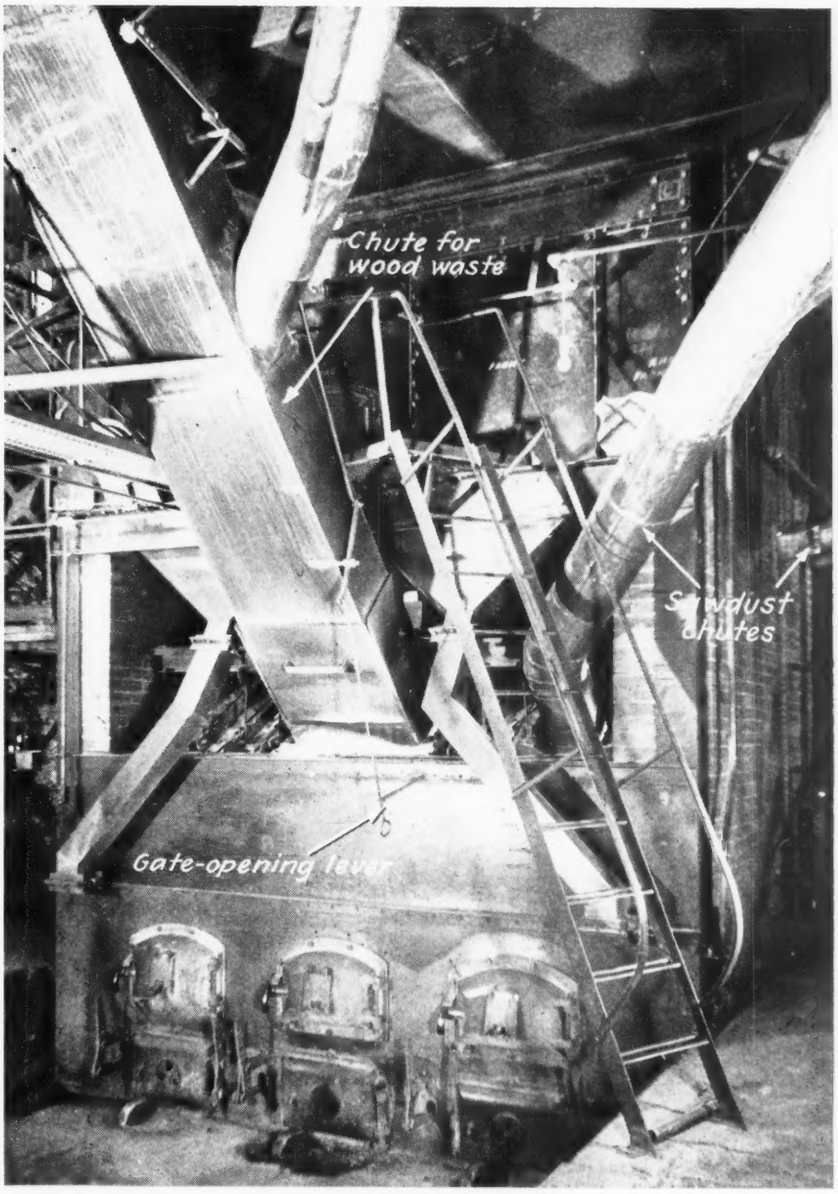
A 125-ft radial-brick stack provides natural draft, which the operator controls by means of the boiler outlet damper. A gage showing furnace and stack draft guides the fireman.

Operating Experience

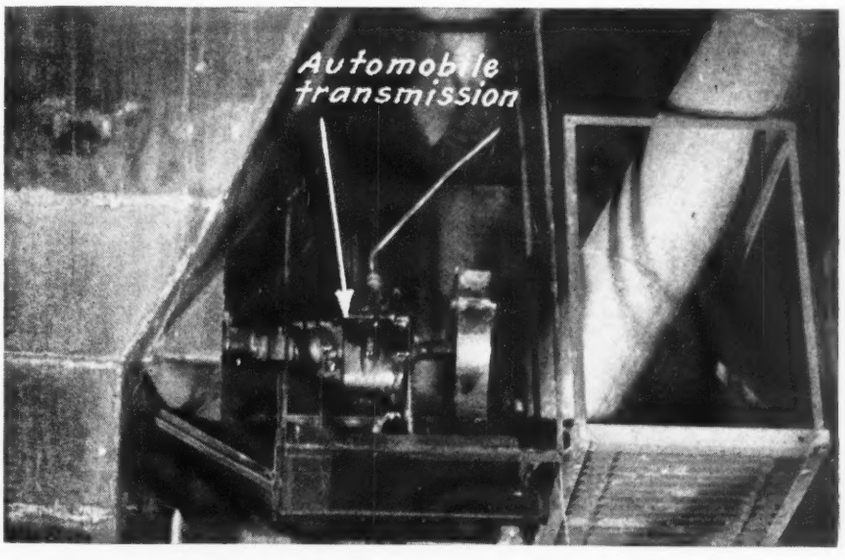
Fire dampers in the feed chutes, hinged to close against backdraft, protect against flarebacks in the chute and cyclones. In the two years of operation there have been no puffs or explosions of any kind. This boiler has seen continuous service since installation except for routine maintenance periods. The only operating difficulty encountered has been slight slagging of the sloping bridgewall at the back of the furnace, caused by sander dust in the fuel. Chief Engineer Jones believes that, were he to do the job over again, he would use a conventional vertical bridgewall in place of the present design, although trouble from this source has not been serious. Regular soot blowing has been sufficient to clean tube surfaces of carried-over particles. Two chutes are provided at the boiler fronts to discharge soot caught in the hoppers in front of the lower drum (see cross section).

Normally the new boiler is the only unit in service. The older units are derated to 92 lb and so can't be paralleled with the 125-lb new unit. In ordinary weather an instantaneous heater, fed from the 125-lb boiler, supplies the forced-circulation hot-water heating system. One of the old boilers has been converted to a hot-water unit and, fired with wood waste and coal, supplements the heater in extremely cold weather. With the new boiler out of service, the three old boilers can just about swing the load.

Chief Engineer Jones would like to install a 300-kw turbine to permit cutting loose from the present standby connection and to furnish exhaust for the kilns and heating. The present engine would serve as a standby.



Location of cyclone collectors on roof dictated sawdust-feed arrangement



Home-made agitator keeps wood waste moving with only occasional "hangups"

Why Watertube Boilers Bulge

Harry Spring explains how bulges form, outlines conditions causing bulging of tubes and drums, and tells how to avoid troubles

MUCH HAS BEEN WRITTEN about bulging of firetube boilers, whose shell plates receive the direct radiant heat from the furnace. An advantage claimed for watertube boilers is that their drums are isolated from the highest temperatures, so that bulging is apparently confined to the tubes. However, the drums can also bulge, as this article will show.

A bulge is a distortion affecting the entire wall thickness of a shell, drum, furnace sheet, or tube; it results from overheating. Usually, scale, oil, or other insulating deposits on the interior surface prevent direct contact between metal and the water which keeps it cool. Under these conditions, metal temperature rises to a point at which the tensile strength is reduced to where it

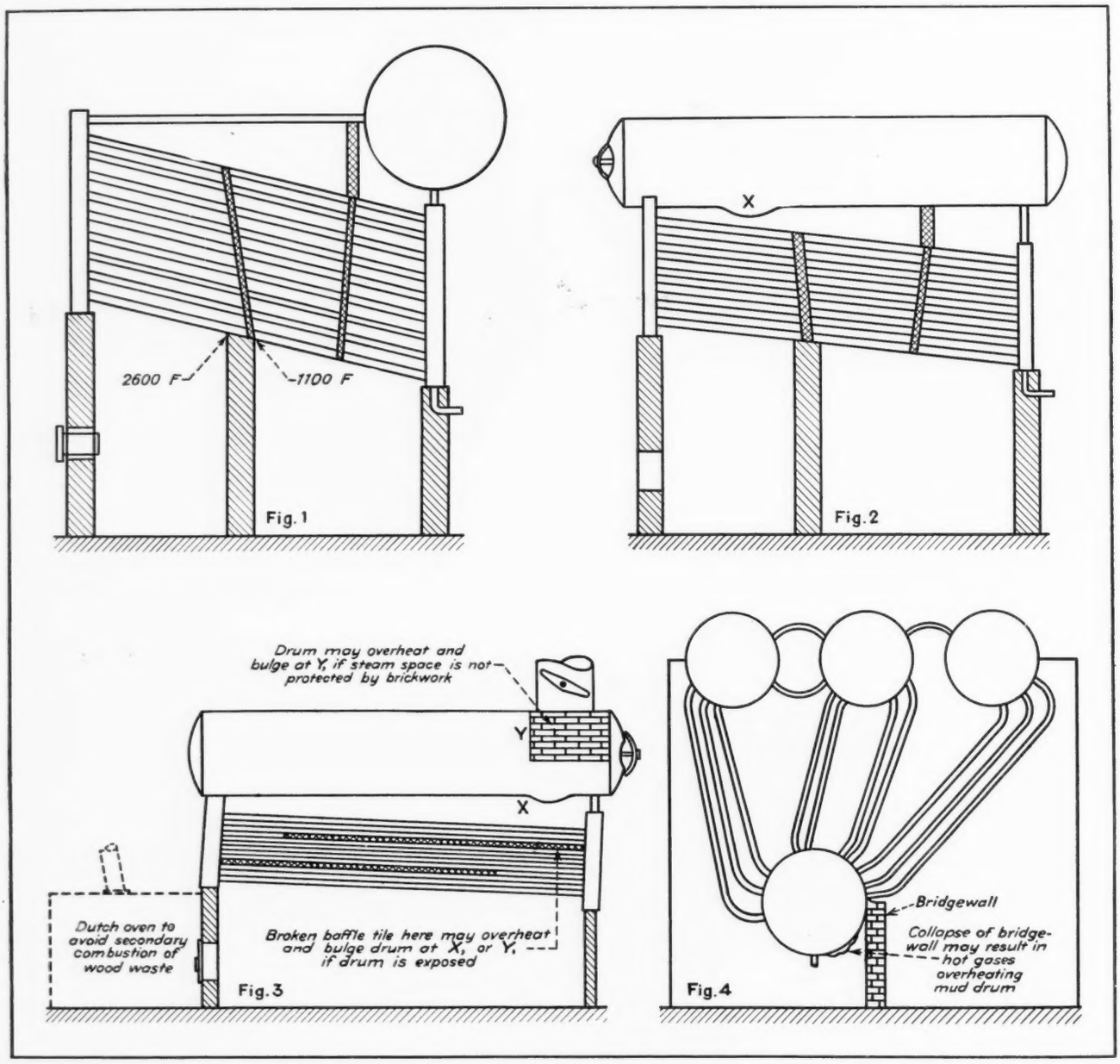

2600 F
1100 F
Fig. 1
X
Fig. 2
Drum may overheat and bulge at Y, if steam space is not protected by brickwork
Y
X
Dutch oven to avoid secondary combustion of wood waste
Broken baffle tile here may overheat and bulge drum at X, or Y, if drum is exposed
Fig. 3
Bridgewall
Collapse of bridgewall may result in hot gases overheating mud drum
Fig. 4

Fig. 1—Tubes may be exposed to high gas-temperature diff erentials when boilers operate at high ratings. Fig. 2—Dirty internal and external conditions may cause the drum to bulge at X. Fig. 3—Heavily sooted tubes, combined with a baffle failure, may cause a bulge at X. Fig. 4—Collapse of bridgewall caused this mud drum to bulge

cannot resist the internal pressure and the metal bulges outward.

Most bulges in watertube boilers occur in the tubes. A bulge in the bottom of a tube forms a pocket for loose scale or sediment and eventual rupture is likely. Renewal of the tube becomes advisable as soon as the depth of the swelling exceeds one-eighth of its length. A less serious bulge can be driven back by an experienced workman. The boiler inspection departments of several localities discourage driving back and recommend new tubes. Repairs should be undertaken only on the advice of an authorized boiler inspector.

Bulges in tubes result from water-circulation starvation, caused by exposed steam-and-water drums. If their internal surfaces are coated with scale, oil, or other deposits, overheating and possible bulging might result. Fig. 2.

A baffle failure in conjunction with heavily sooted tubes in a horizontally baffled boiler might cause bulging of the rear part of the drum if its internal surface is not clean. Fig. 3. Collapse of a bridge wall in a bent-tube boiler may bulge the mud drum. Fig. 4. This would be caused by flame impingement or overheating where there might be scale or oil on the internal surfaces. Bulging of a steam-and-water drum because of low water is also a possibility. Fig. 5.

Overheating in the steam space of a watertube boiler drum is rather uncommon. With the box-header boiler, Fig. 3, broken baffles and sooted tubes result in high-temperature gas flowing over the steam space. The drum of this boiler is usually covered with brick at the gas-exit point, as protection against overheating. If the brick work is omitted, overheating might occur, particularly when there is secondary combustion while burning wood waste and sawdust.

Secondary combustion results from incomplete combustion in the furnace. Particles of unburned or partially burned sawdust carry over through the gas passages and top part of the boiler. If the gas temperature is high enough to cause ignition, and there is sufficient free oxygen in the flue gases, secondary combustion will occur.

Incomplete combustion can be corrected by increasing the furnace volume. This can be done by installing a Dutch oven. Fig. 3. Here, the longer flame path should permit complete combustion of the sawdust particles before they strike the surfaces that cool them.

A dished head of a watertube boiler may also bulge. Installing a 2-drum bent-tube watertube boiler without proper pitch, combined with excessive gas temperatures in the second pass, might cause heating and bulging of the mud-drum front head. The excessive gas temperatures could result from a collapsed bridge wall. Operation at high ratings with a collapsed bridge wall will cause serious difficulties, even though the boiler were erected with proper pitch. Fig. 6.

Bulging of a drum in a watertube boiler is extremely serious, and as a rule the drum should be replaced. An inspection by a qualified boiler inspector should precede any decision for repairs or further operation.

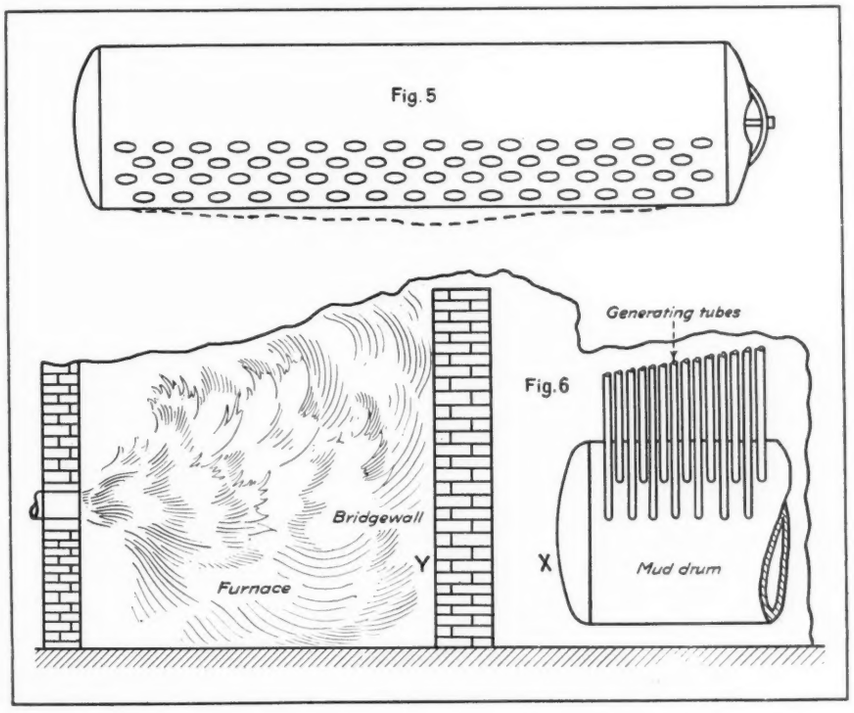


Fig. 5—Dotted lines show how steam drum of Fig. 4 might bulge because of low water. Fig. 6—Bulge might be expected at *X* if bridgewall collapses at *Y*

✦ ✦ ✦

Wrong Connections Cause Motor Troubles

SQUIRREL-CAGE MOTORS are simple in construction and easy to maintain. Yet, some of the troubles that may develop in them are difficult to locate, even for an experienced man. A fault that may occur on new as well as on old machines is a short-circuit between one or more turns in a stator coil. Even though the voltage induced in the short-circuited turn or turns may be low, heating of the coil will be sufficient to cause a noticeable odor of insulation and may reduce the motor torque. If such a condition is permitted to continue it may eventually burn out some of the coils. Coils in this condition can generally be detected by their temperature.

A 10-hp, 3-phase motor, in operation for a few months, became unable to drive its load. When started it came up to speed but when load was applied it made a whistling sound, slowed down, and the winding insulation started to smoke. At first we thought that the windings were short-circuited, but finally found that they were connected two-parallel star and that one circuit was open. This reduced motor hp by about 50%. We had a similar experience with a 2-phase motor. Here again it was found that each phase winding was divided and connected in two parallels and that one circuit was open in one phase.

READERS' PROBLEMS

Questions from Our Readers

Cable Damage

Question 1

I WILL SOON BE RESPONSIBLE *for pulling control cable into long runs of conduit. This cable is the usual 6-, 8-, and 12-conductor with rubber insulation and fabric-braid covering. As the runs are long and have numerous bends, how will I know what pulling force to apply, and is there any limiting device which I can use to prevent stretching the cable? Is it possible that under this condition cable may be stretched to such an extent that the insulation will fail between conductors?*—RLZ

V-Belt Tension

Question 2

WE HAVE HAD A LOT OF DISCUSSION *in our plant about the effects of unequal stretch of multiple V-belts. Some of my associates claim that, if each belt takes its share of the load, unequal stretch makes no difference, while others are equally certain that it does. The latter is apparently the generally accepted opinion among industrial engineers, and V-belt manufacturers match their belts for length. However, I have not found any good reason why and how a small difference in the length of several V-belts operating in parallel affects their operation. Maybe some* POWER *readers can enlighten me and my associates on this apparently debatable point.*—CR

How to Ventilate

Answers to Oct Question 1

The Question

OUR PROBLEM *is one of ventilation. I have attempted to rough sketch a plan of the particular department. There are approximately 100 girls working in this room, as well as eight men operating sewing machines and steam presses. We have attempted to use ordinary blow fans to circulate the air, but they only spread the hot air and steam from the presses. On a normal summer day, about 87 F outside, the temperature in the room will be over 100 F with all windows open. Would it be advisable to install two exhaust fans, one on each side, as indicated in the sketch, or is there a better solution? Perhaps there is some way to control the humidity caused by the steam presses, which cover approximately 300 sq ft of floor space, fairly close to the center of the department.*—GHA

Wind Drift Helps Ventilation

THE CONDITIONS OF GHA'S DEPARTMENT make the system of ventilation he proposes entirely unsuitable to the layout shown. With the windows open, and the wind or air drift from one side of the building, the exhaust fan on that side would be ineffective. Unless it was carried away by a duct, heated air drawn from the department would simply eddy back into the windows farther along the wall. Besides, the steam-laden air from near the presses would be drawn directly across the sewing machines one way, and a cutting table the other.

A far better method of ventilating this department would be to install a duct with an intake directly over the steam presses. If the floors above this department permit, a small shaft alongside the elevator would be ideal. If a shaft cannot be installed, then an overhead duct opening in the general area of the steam presses should serve equally well. The duct should pass out through the wall near one corner of the room, and should be equipped with a fan or blower. With a pressure blower the duct can be made reasonably small, and may be carried along the ceiling against a beam or along the wall.

A study of the accompanying sketch, (1), will enable GHA to see the advisability of exhausting the air from an area near the steam presses. With the intake somewhere near the position shown, the steam and heated air in the vicinity will be exhausted by the fan. Drift of fresh air coming in at the windows will be toward this point, as shown by the arrows.

Menard, Ill. GEORGE HOLMAN

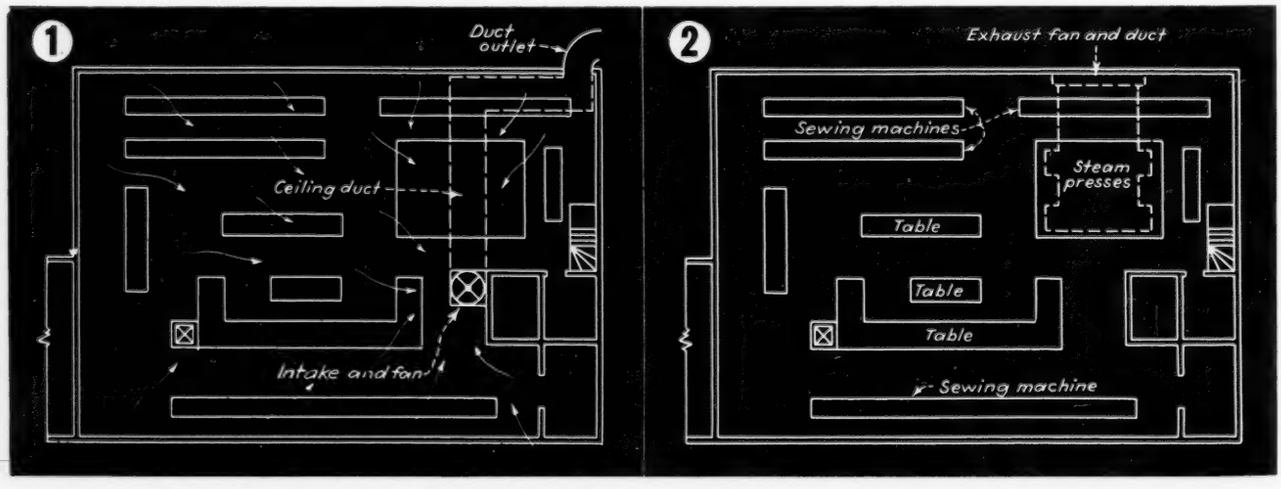
Relocate the Fans

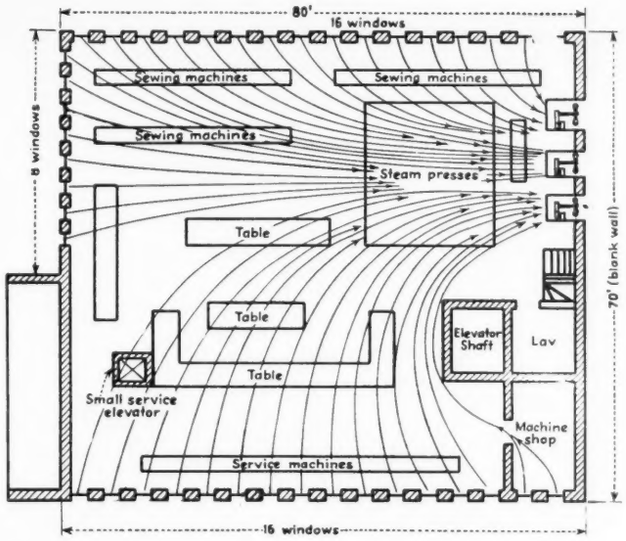
GHA WILL HELP CONDITIONS with the exhaust fans installed as planned but they should be installed as close to the ceiling as possible. One fan should be near the presses so that there will be a more direct movement of air from the presses to the fan. If the presses are to remain in the same place for several years, it is advisable to install exhaust ducts directly over them, (2). The air movement through the room will then be toward the presses, which will prevent the steam from spreading to the surrounding parts of the room.

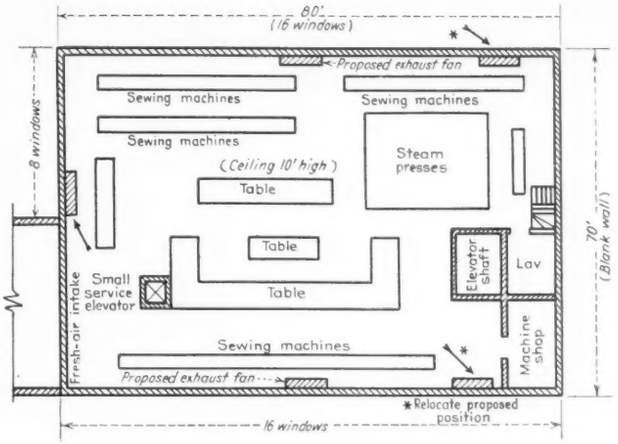
Lombard, Ill. H D BROWN

Suggests Exhaust Fans Plus Window Adjustment

GHA REPORTS THAT THE BLOWER FANS spread the hot air. This is the disadvantage of blowers where heat-radiating equipment, such as the steam press, is involved. If GHA will install fans in the wall as shown on the drawing (next pg), and will open the windows nearest the fans a small amount, gradually increasing the openings of the windows until those fartherest







from the fans are wide open, he will get good results.

By trial and error he will find the correct opening for each window. He should then install stops so that they cannot be opened past their setting. This will cause an air flow as shown by the arrows, with a high air velocity passing the press, and the heat from the press will be exhausted directly to the outside of the building.

If GHA's department happens to be the top floor of the building he should install fans on the roof above the steam press, which will have a marked effect on the humidity, as the steam will not be spread around the room. I would recommend two or three 21,000-cfm fans.

Chappell, S. C. R J McBURNEY

Change Fan Location

GHA'S CONDITION CAN BE IMPROVED at minimum expense by installing his blowers at a different location. This location is shown on the sketch directly above together with a suggested fresh-air blower. Awnings installed over the windows will eliminate considerable radiant heat from the sun. To control humidity will require installation of additional equipment and it is suggested that GHA consult reliable manufacturers in this field.

Schenectady, N. Y. CARL BACHMANN

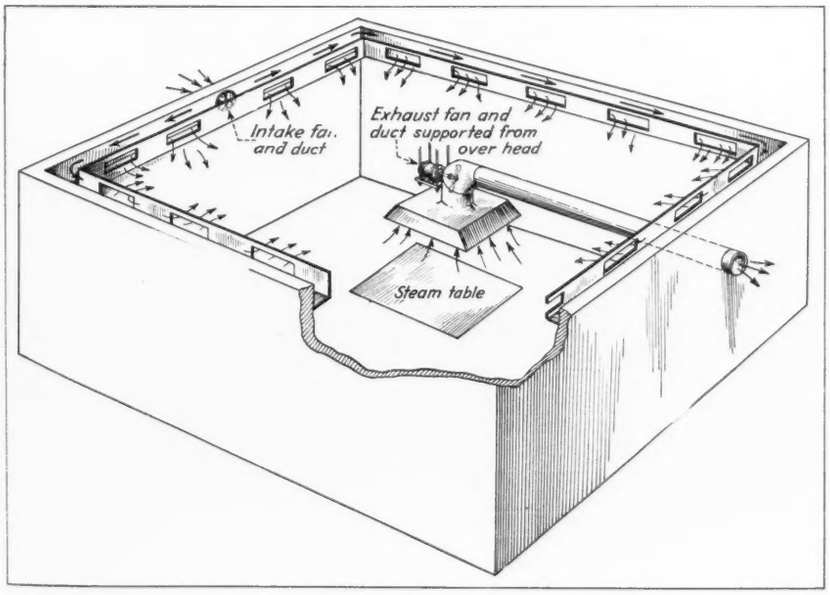
Forced Ventilation

GHA SEEMS TO HAVE A PROBLEM calling for air conditioning and it may be advisable to consult a reliable firm regarding the same. However, if this does not seem warranted I would suggest that the arrangement shown in the accompanying sketch be installed. Exhaust fans as suggested in the question would not be advisable as these would tend to carry steam from the presses about the room rather than confine it. A motor-driven fan, which can be suspended from the ceiling, will carry the vapor, direct from the source, out through the blank wall. This will eliminate the possibility of the vapor being drawn in again by way of the windows.

This would do much to solve the problem, and having 40 windows to admit outside air there should be little further trouble. However if this is found to be insufficient, then the suction fan and duct shown should be installed, drawing fresh air in through the opposite wall and distributing it through a duct fitted around the entire room.

With this arrangement a flexible system is available. The intake fan may be used as required, or the windows may be opened to suit conditions. The flow will then carry humid air toward the exhaust fan, to be discharged through the wall.

Kearny, N. J. GEORGE MCNALLY



Steam Press is Culprit

ACCORDING TO THE INFORMATION and sketch presented by GHA, the steam presses appear to be the source of all his trouble. I believe that instead of the proposed exhaust fans at each side of the room, he should concentrate on removal of the vapor and heat given off by the steam presses.

To do this a duct with several flared openings projecting downward, or at an angle, could be erected on the ceiling and across the center of the steam press. The duct would then be connected to the suction side of an exhaust fan located close to the blank wall shown on GHA's sketch. A hole large enough for exhaust-fan discharge could be knocked in the wall. In this manner the exhaust vapor from the fan would be kept clear of the windows.

This method would materially reduce the humidity of the room by removing the cause of the excess heat at its source.

Parkchester, N. Y. DANIEL DONOVAN

Reduce Humidity

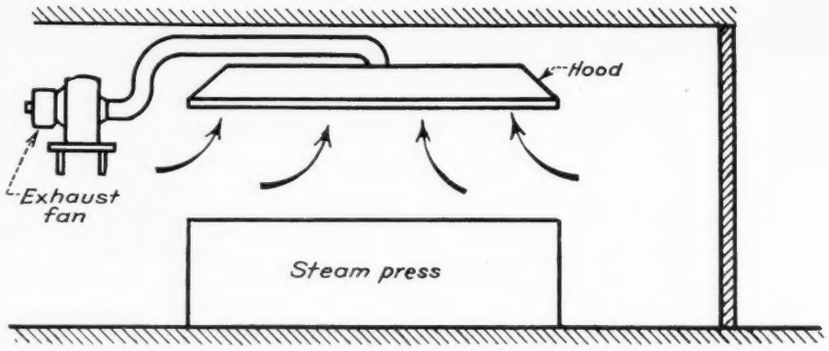
THE FAN ARRANGEMENT SHOWN on the sketch accompanying GHA's inquiry would possibly improve conditions, but apparently the chief cause of trouble is the steam press. His arrangement does not prevent mixing steam with room air, giving rise to a high degree of humidity. If, however, a hood of ample area was installed over the press, and all the air in the room, together with the steam, exhausted through it little of the steam would circulate in the room.

The cubic content of the room appears to be somewhat less than 60,000 cu ft and

a fan handling 3,000 cfm would give three air changes an hour, which should be satisfactory. If, however, we consider an area of 300 sq ft at the press, with a height of ten feet, we get 3,000 cu ft and our fan would insure one change a minute at this point. Ordinary window ventilators, such as can be obtained at any hardware store, could be installed in the windows as needed. This would admit an adequate supply of fresh air, at points to provide the most satisfactory distribution.

Bloomfield, N. J. J O G GIBBONS

(More answers to Question 1 on pg 146)



Pumps Lose Suction

Answers to Oct Question 2

The Question

WE EXPERIENCE DIFFICULTY *with two 3-in. centrifugal pumps, each direct-driven by 5-hp squirrel-cage, 3-phase motors. The pumps have a common suction and delivery; they fill a remote storage tank at 80 ft head, under control of a single-phase float switch. The water spills into the top of the reservoir for aeration.*

Each pump is equipped with stop valves and the units are intended to operate separately, one acting as standby for the other. The suctions are connected and go straight down through the concrete pump-house floor in a 3-in. bore-pipe, which had been used for a smaller installation. The suction pipe had to be reduced to 2½ in. and fitted with a vertical check valve which just slides down the bore-pipe. The suction lift is about 18–21 ft.

Each motor has a magnetic starter with a single-phase solenoid operated by the float switch. In addition, each circuit is equipped with a phase-failure, phase-reversal cut-out. The wiring is such that a two-way manual switch can put either set into operation.

Trouble has been encountered through the pump losing the suction in periods of dry weather. They are intended to run unattended except for a weekly visit. It is not practical to dig up the floor, and put down a large bore or well with float control, which would be the simplest solution. I have been considering various alterations for protecting the units and would like to hear what POWER *readers have to suggest.*—ETG

Positive Priming Hook-up

ALTHOUGH ETG DOES NOT DEFINITELY SAY SO, it is assumed that the vertical check valve in the 2½-in. suction line is a foot valve installed at the end of the pipe. A foot valve is quite necessary at this point, and it is important that it should not leak, although the hookup shown on the accompanying sketch should largely overcome trouble due to a leaky valve. The electric controls for the pumps are not shown, but the control switch shown for the solenoid valve should be combined with, and operate as part of, the pump-control float switch at the reservoir.

As will be seen, the pump suction will be continuously primed, except when one of the pumps is actually operating. Immediately the float switch at the reservoir operates to start the pump, the solenoid valve will close, and cut the priming tank off from the pump suction.

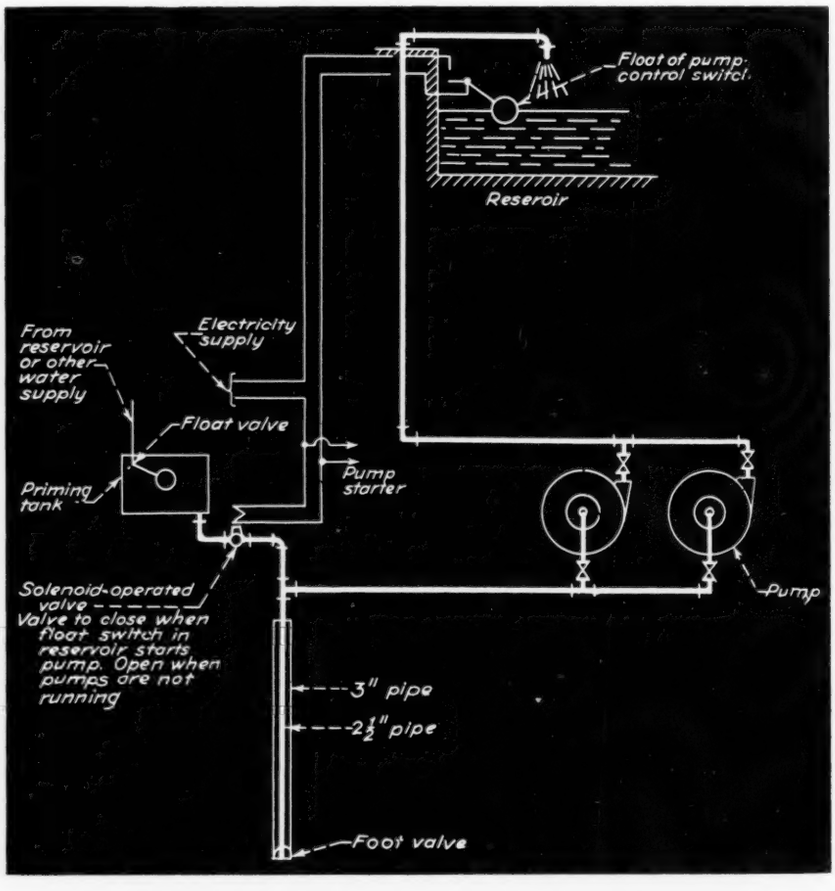
A 20-ft. suction lift is, of course, somewhat excessive, and care should be taken that the suction line has no air leaks, and that the pumps are in first-class operating condition.

Bloomfield, N. J. J O G GIBBONS

Vacuum Control

ETG'S DIFFICULTY IN MAINTAINING SUCTION on his pumps is likely due to one of two basic troubles: either the pump is not capable of pulling a lift as high as is encountered, or air is leaking into the suction line at the pipe joints.

The first of these possibilities is the less likely, for a 3-in. pump operating against an 80-ft head should have no trouble in maintaining a lift of 18-21 ft. It is, however, possible that in dry periods the water level in the sump falls considerably below the normal level and the lift in this case is greater than 18-21 ft. If this is true, ETG can do one of two things; he can check with the pump manufacturer to determine if he can obtain an impeller which has better lift characteristics, or he can throttle the pump discharge. The suction lift a pump can handle decreases as the capacity increases; consequently, if the pumps are throttled they will work back on their curve at points of less than normal capacity and at these points they are capable of handling a higher lift than when operating further out on the curve. Throttling is an expensive process and



if the pumps are to operate a great deal in dry weather the automatic priming system described later should be used.

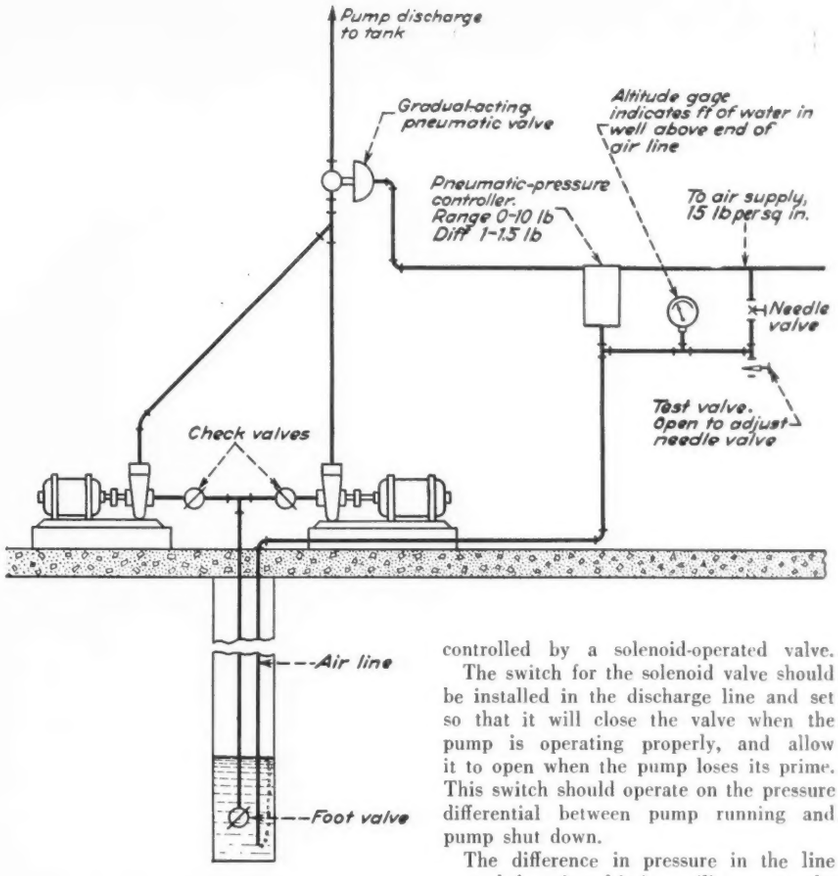
Air leakage may be the result of several causes. The most common are loose joints in the suction line, which are easily fixed by tightening. The connections and piping which carry the sealing water to the stuffing boxes should be checked to see that they are free of obstructions. The sealing connections are shown by sketch A, below. Small check valves are placed on either side of the casing to prevent the sealing water from going into the casing of the idle pump and insure its entry into the stuffing boxes to serve as the necessary seal.

The depth the suction pipe extends below the water surface should be checked. Normally this distance should be 3 ft or more to prevent the formation of a vortex at the suction pipe with consequent air leakage into the suction.

Should all of these simpler methods fail to give satisfactory results, a system of priming and maintaining the prime as shown in sketch B is the best solution.

Briefly this system operates as follows: A vacuum pump which extracts all air from the pump casing and from the suction line is installed. A float chamber is placed on the suction pipe as close to the pumps as possible and with the top as far above the top of the casing as is necessary for the ball float in the chamber to rise above the top of the casing. This prevents the stopping of the vacuum pump before the casing is completely filled with water. The primary float valve which controls the centrifugal pumps is also connected to the vacuum pump which will thus only operate when the centrifugal pumps are to operate. A time-delay switch is placed on the centrifugal-pump motors. When the primary float valve is in such a position that the centrifugals are to operate, the vacuum pumps will go into operation and evacuate all the air from the suction line and the casing. As the water fills the float chamber, the float rises and trips a mercury switch, which in turn shuts off the vacuum pump. The time-delay switch then cuts in the centrifugals and thus it is seen that the centrifugals will not operate dry. The time-delay switch is set for the time necessary to evacuate the air from the suction line, which will be about 3 or 4 minutes depending upon the vacuum pump installed. If, at any time, air leaks into the system, the float will fall with the water level in the float chamber and start the vacuum pump which removes the air from the system. This will not affect the centrifugals since they are actuated by the primary float and time switch only. The vacuum pump cuts in when there is only a small amount of air leakage and there is no danger of the centrifugals being in operation dry or partially dry. When the required pumping is completed the primary float switch shuts off the entire system.

New York, N. Y. K E Blessing


Pump discharge to tank
Gradual-acting pneumatic valve
Altitude gage indicates ft of water in well above end of air line
Pneumatic-pressure controller. Range 0-10 lb Diff 1-1.5 lb
To air supply, 15 lb per sq in.
Needle valve
Test valve. Open to adjust needle valve
Check valves
Air line
Foot valve

Automatic Pressure Switch

ETG can prevent his pump from operating without water by installing an automatic vent on the pump, and a bypass line from the discharge to the suction line, controlled by a solenoid-operated valve.

The switch for the solenoid valve should be installed in the discharge line and set so that it will close the valve when the pump is operating properly, and allow it to open when the pump loses its prime. This switch should operate on the pressure differential between pump running and pump shut down.

The difference in pressure in the line caused by pipe friction will operate the control switch after the switch is adjusted for this pressure differential.

The foot valve must seat properly to prevent leakage from the reservoir back to the well.

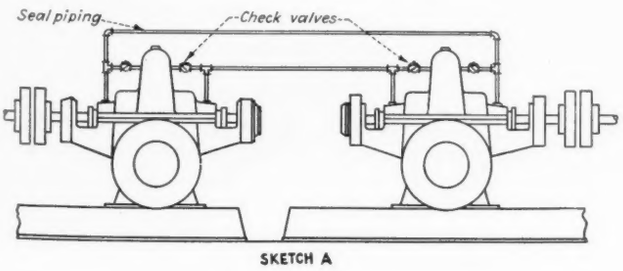
Lombard, Ill. H D Brown

Complete Control

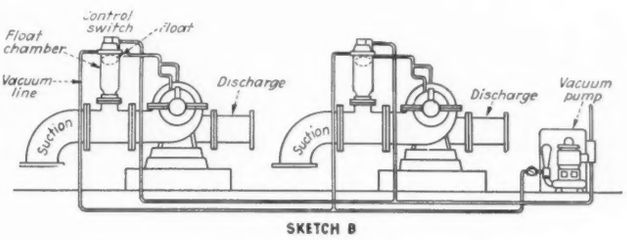
While ETG's installation is not described in sufficient detail to include all factors of operation, it is reasonable to assume that the suction lift as given is a static measurement and that dynamic losses bring the total suction lift to approximately 25 ft. The pumps are evidently operating at the maximum lift, and any means of reducing this lift should help. Since the operation is automatic it is probable that it is also intermittent, and the pumps lose their prime when well level is lowered by excessive pumping.

Thus it would seem desirable to provide automatic priming, automatic shutdown in case of abnormal draw down of the well, and to reduce losses in the suction system. All these features may be combined into a relatively simple system: (1) Eliminate the foot valve, which is unquestionably a major source of suction loss, (2) If the casing is in good condition, use it as a suction pipe, thus gaining one-half inch in pipe size and further reducing the friction loss, and, (3) Connect the pumps with short straight lengths

(Continued on page 148)



SKETCH A



SKETCH B

PRACTICAL AIDS TO OPERATION

Micarta Increases Guide-Bearing Life

SUBSTITUTION OF MICARTA for lignum vitae (a natural tropical wood) by a western utility has increased the life of waterwheel guide bearings from 3.5 to 14 years. Before the changeover was made, the lignum vitae in these bearings was replaced on the average of once every 3 or 4 years. Originally installed with a clearance of 0.015 in., the bearing wore 0.05 in. in this time. Changing a bearing involved a labor cost of about $100 and a loss of 20 hr of power generation.

Due to the low water-absorption of Micarta it was possible to install the bearing with a clearance of 0.009 in., three-fifths the clearance when lignum vitae was used. During the last 4 years the bearing wear has averaged 0.0025 in. per year compared to 0.015 in. for lignum vitae. Since 0.050 in. is considered the maximum allowable clearance, it is expected that the Micarta will last at least 14 years, or about 4 times as long as lignum vitae.

New York, N. Y. FIELD EDITOR

Reversed Valve Rod Cures Packing Trouble

ONE OF OUR HIGH-SPEED TANDEM-COMPOUND ENGINES, direct connected to a dc generator, had been operating for a number of years at about half rated capacity. The high-pressure valve rod got slightly worn at the packing gland on the engine valve chest, but could be kept steam-tight as the load on the engine was light and fairly constant and the valve travel so small that it did not exceed the worn section.

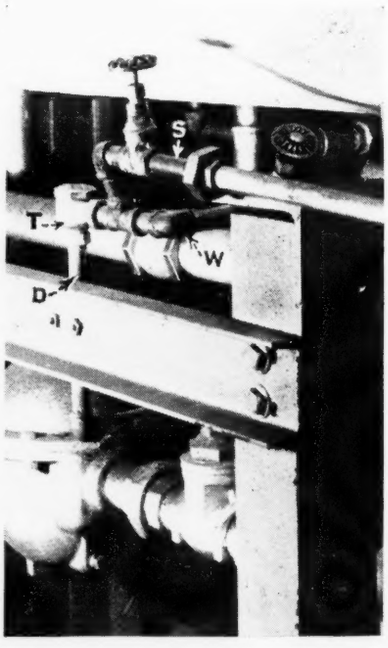
Extra elevators and new equipment were installed in the buildings supplied by our power plant, with a resultant increase in engine load and in slide-valve travel. Under this condition we couldn't keep the packing gland tight, because two different valve-rod diameters were operating in the packing; that is, the worn part and the original diameter.

We were faced with the problem of ordering a new valve rod or repairing the existing one. When we removed the valve-chest cover to measure the rod, we discovered that by reversing the rod and cutting a few extra threads for one of the slide-valve locknuts, we had the equivalent of a new rod. This was done, the valve reset, and indicator-card readings taken for accuracy. We now have a steam-tight packing gland and the governor behaves perfectly under all loads.

Bronx, N. Y. ANTHONY GREER

Easy Test for Radiator Traps

IF YOU WANT EQUIPMENT TESTED, make the job easy. This is just what we have done with the elements on our radiator traps. As shown in the photo, we connected trap body *T* into a line with a



low-pressure steam connection *S* and water connection *W*. Outlet of the trap connects to a drain tank by pipe *D*.

When we have any doubt about whether or not a radiator trap is operating properly, the trap element is replaced by one that has been tested. The doubtful one is brought to the shop and put into the test body. Then low-pressure stream turned on. If the traps hold steam, the steam is shut off and the

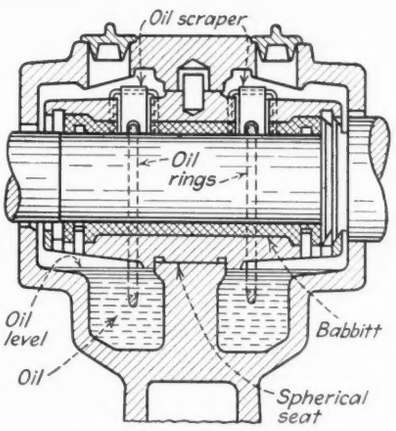
water valve opened. If the element passes these two tests it goes into stock, if it fails to pass them it is thrown into the discard.

New York, N. Y. P E MEREDITH
Chief Engineer, Eldorado Hotel

Oil-Ring Scrapers Stop Bearing Heating

HOT-BEARING CURES ARE ALMOST LEGION, but I am going to add another to the list. A bearing on a belt-driven generator ran hot. This bearing was crowded against the wall, where it could not be reached easily and from what I was able to see, sufficient oil was not flowing off the rings onto the shaft.

To correct this condition I drilled a 1/8-in. hole in the top of the bearing on each side of the slots for the rings. Then I bent two pieces of No. 14 copper wire U-shaped to fit into the holes and form a bridge across each ring. From a piece of sheet copper I made



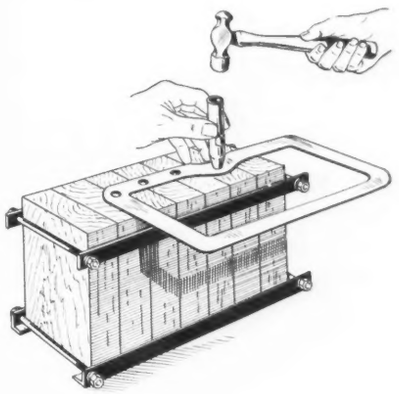
two oil scrapers that would fit their lower ends lightly around the rings, when their upper ends were bent around the wire bridges, as in the figure. This little trick cured the trouble. When placing the scrapers, care was taken to prevent their interfering with free ring movement.

Riverdale, N. Y. ALEX GRAY
Chief Engineer, Colored Orphan Asylum

Wood Block for Punch Work

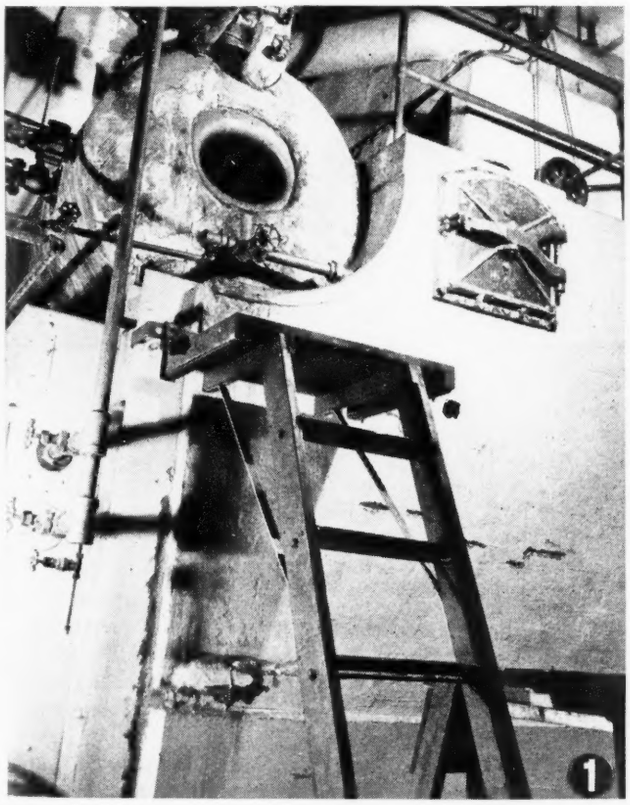
IN OUR SHOP WE NEEDED A WOOD BLOCK on which to punch holes in gaskets, in ends of belts for lacing and in other non-metallic materials. A large block was not available for this purpose so we made one from short lengths of plank, assembled as in the diagram.

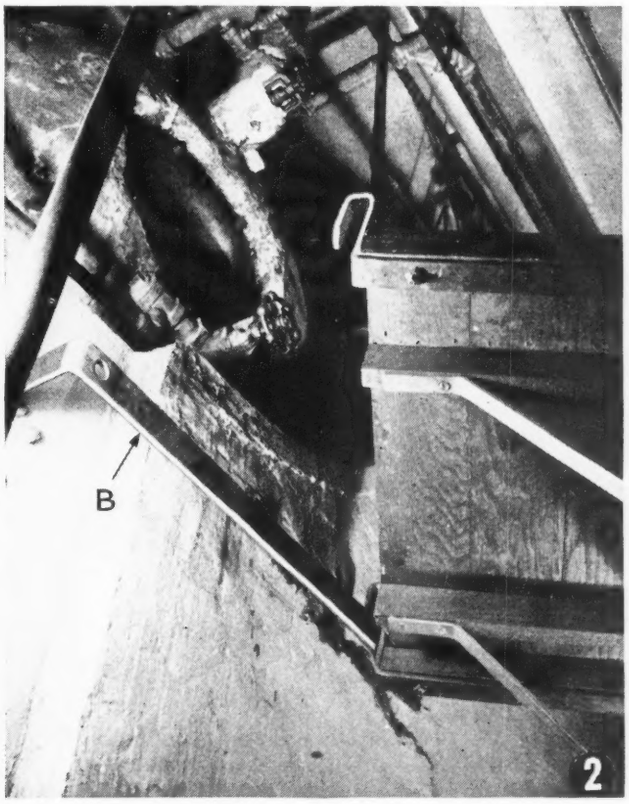
Penacook, N. H. C H WILLEY



Ladder for Safe Access to Boiler Drums

LADDERS TO OVERHEAD BOILER DRUMS must be securely fastened if accidents are to be avoided. Entrance to or exit from a manhole can be made much easier if a suitable platform ladder is provided. We built such a ladder for our plant, as shown in Fig. 1, and fitted it with adequate holding hooks. These hooks slip over strap-iron brackets, Fig. 2, fastened to the boiler structure below each drum end. This ladder and a set of brackets on each of the four boilers in





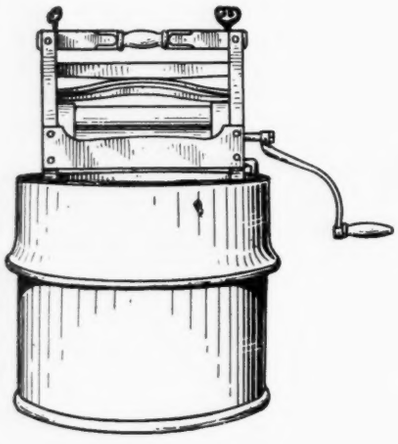
our plant have fully paid their way by eliminating accidents to operators entering or leaving the drums.

New York, N. Y. FRANK SMART
Chief Engineer, Beth Israel Hospital

Wringer Saves Oil And Oily Waste

ON MOST ENGINES, especially older ones, oil seepage occurs at numerous places and is hard to stop. Cotton waste is usually packed around these spots and is then disposed of when oil soaked.

We made a device that was responsible for a considerable saving in waste and oil. We constructed it from a clothes wringer mounted on part of an oil drum, as in the figure. The oily waste is run through the wringer which removes the excess oil, allowing the



waste to be reused. The recovered oil is purified and returned to the system. Including both waste and oil, we make a saving of $21 per month.

Custer, S. D. H O MUNSON

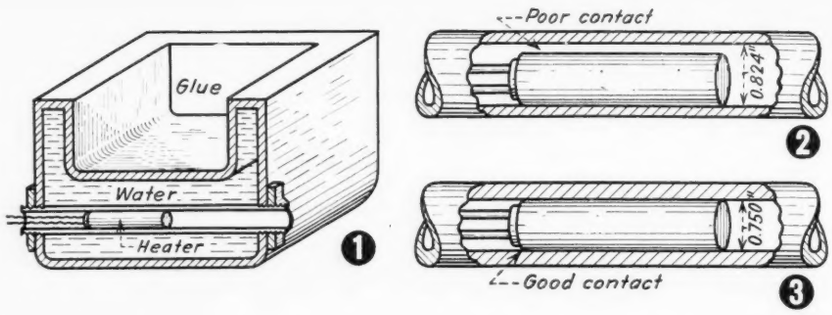
Indicating Ammeter Prevents Motor Overloads

ON MANY OPERATIONS IN INDUSTRIAL PLANTS the load on motors is controlled by the machine operator. In our plant we have several machines for drawing heavy wire, driven by 50-hp adjustable-speed dc motors. The characteristics of the metal being drawn into wire, the amount of reduction through the die and the rate of drawing all influence the load on the motors and must be taken into account.

We had trouble with these motors overheating because operators made too-heavy reductions, made the draw at too-high speed, or both. To overcome this we installed an indicating ammeter on each motor and located this meter where it was easily observable by the operator. To make it simple for the operator to keep the load within safe limits we put a large red division on the scale, representing maximum safe load on the motor. As loads are intermittent, we did some experimenting to find the maximum load the motor would drive without overheating. This we found to be about 25% above normal rating of the motor.

When we have any doubts about the way an operator is handling a machine, we connect in a recording ammeter and let it remain in the motor circuit for a few days. This gives us a permanent record of machine operation.

By working with the machine operators to help them and us get a better understanding of the drawing process, we have obtained their wholehearted cooperation. We have determined the speed that should be used for the different draws, and the power required to make them. When the ammeter shows a serious deviation from normal the operator calls attention to the change and the cause is found and corrected. In this way we are able to get a more



Poor Contact Causes Electric-Heater Trouble

WE USE DOUBLE-JACKETED GLUE POTS with electric heaters placed inside brass tubes, Fig. 1. As originally designed, standard 1-in. OD pipe was used for the brass tube to contain the heaters. As the heaters were only 0.748 in. in diameter and the pipe was 0.824 in. the heaters made poor contact with the pipe (Fig. 2), overheated and burned out in about 3 months.

To correct this difficulty I used extra-heavy brass pipe, which has an inside diameter of 0.742 in. Running a 0.75-in. reamer through the tube increased the inside diameter so that the heaters would go in with a push fit, Fig. 3.

At the top of the photograph is what was left of a heater after three months in the larger tube. The bottom heater was installed in one of the new tubes and after one year's service apparently is in as good condition as when installed. This experience emphasizes the importance of having electric heaters make good contact with the medium that they are to heat no matter where they are used.

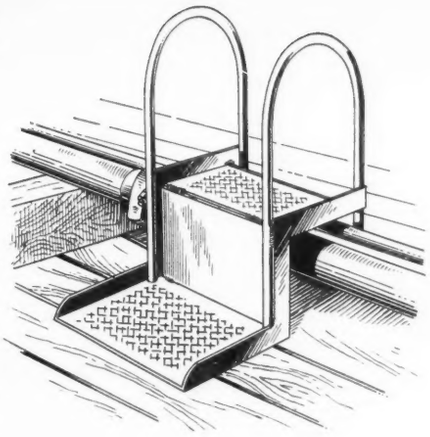
Englewood, N. J. R BOETTINGER

uniform product, something quite difficult to do before installing the meters.

Boston, Mass. B R STEWART

Safety Cross-Over for Hot Pipes

ON CONSTRUCTION WORK where employees had to cross over hot bare pipes, we installed the safety steps shown in the drawing. These were made by welding safety-tread plates to an angle-iron form to guard all exposed edges. A pair of pipe loops, tack-welded into place

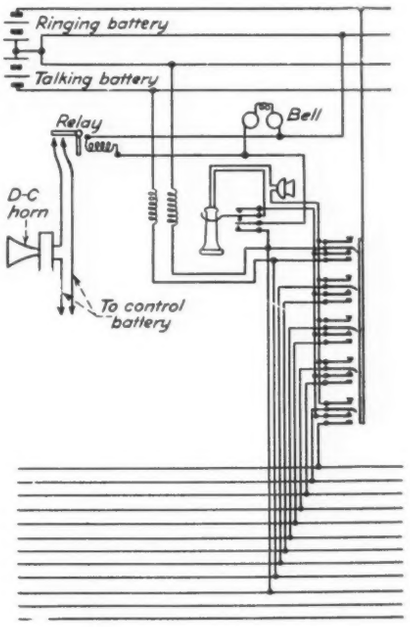


serve as hand rails. Air circulation around the steps was sufficient to prevent their reaching a dangerous temperature. Weight of the cross-over is sufficient to hold it in place without fastening, yet is light enough so it can be easily moved to other locations.

Houston, Texas M T PATE

Add Loud Horns to Plant-Phone System

COMMUNICATION BETWEEN THE FIREMAN, water tender, and pump-room-attendant was quite difficult in our plant because these stations were widely separated. The plant inter-communicating telephone was satisfactory for talking, but the men were usually too far away



to hear the phone bell. It was then necessary to call the control room and ask that operator to call the man wanted by means of the horn-calling system. This caused operating delays which might have proven serious in the event of an emergency.

We solved this problem by connecting a telephone relay and horn at each of the important stations in the plant. The relays are connected in parallel with the phone bells as in the diagram. We selected the relays for use with the telephone-ringing battery having contacts to carry the current taken by a dc horn operated from the station-control battery. This allows any phone station to call any of these men direct and leaves the control-room phones free for calls directly concerned with plant operation.

Duluth, Minn. GEORGE I SMITH

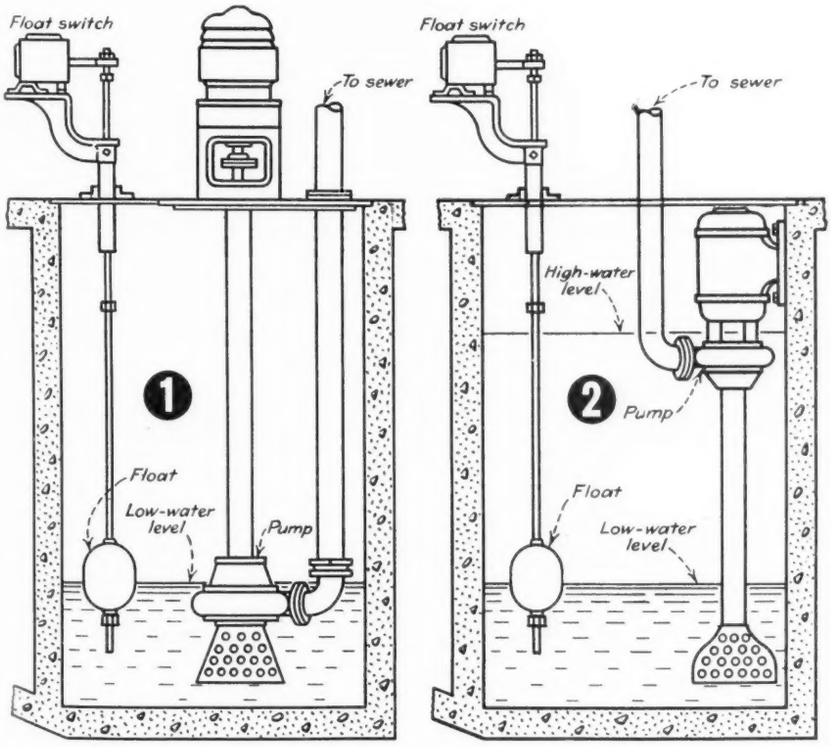
Motor Pump Applied to Sump Service

IN THESE TIMES IT IS DIFFICULT to get equipment because of the defense-program requirements and it is well to have in mind substitute possibilities. For example, in one plant a vertical sump pump like that in Fig. 1 was needed, but could not be readily obtained. A close-coupled ball-bearing motor pump of proper size was available for quick delivery. These pumps can be operated in either a horizontal or vertical position.

Fig. 2 shows how one is installed in the sump so that the pump-casing is just below high-water level. In this position the pump is primed before being started by the float switch. Limits on the float-switch rod are set so that the switch closes when the water level rises to just above the pump casing, and stops the pump when the sump is nearly empty. The low-level of the float should be set so that the pump will be stopped before it begins to draw air.

With the pump primed as in Fig. 2 at starting, it can operate satisfactorily with a suction lift up to 15 ft or more and can thus be used in sumps up to that depth. This type of installation, where it can be used, permits utilizing a wide range of capacities and heads, and is frequently more economical than the conventional submerged pump.

New York, N. Y., FRANK A KRISTAL



How to Use Vector Diagrams

By PHIL SWAIN

WHEN SEVERAL FORCES act on the same point their combined effect can be represented by a single force called the *resultant* of the original forces. A force is a so-called *vector* quantity because it has direction as well as amount. A gallon is *not* a vector quantity because it has no direction. Aside from forces, common vector quantities are movements and velocities.

It is obvious that any vector quantity can be represented by an arrow pointing in the proper direction with a length proportional to the quantity represented. This article will confine itself to vectors all in the same plane.

Vectors are easy to understand if we start with simple movement on a flat surface. For example, a man walks 5 miles east, 4 miles northwest and 6 miles west. What is the net effect? Fig. 1 plots his journey (*A*, *B*, *C*, *D*) and shows at once that the net effect is a journey from *A* to *D*. This is properly represented, both in amount and direction, by the vector *AD*, drawn from the start to the finish. The result would be exactly the same if the man took the same hops in a different order as shown in Fig. 2.

Rule for Vectors

It is now time to give the rule for adding vectors: "Place them end on end in any order, with the arrows all running in the same sense." *Be sure not to change the direction of any vector.* An arrow drawn from the tail of the string to the point of the string is the *vector sum* or *resultant*. This rule applies equally well to movements, velocities, forces or any other vectors.

Fig. 3 shows the application of rule to velocities. The boat is moving 10 mph northeast *through the water*, but the water is flowing south 5 mph. Placing these two vectors end to end as shown, we get the heavy arrow which is the resultant speed (and direction) of the boat's movement over bottom.

The application of this vector rule to forces is of particular interest in mechanical engineering. Fig 4*A* shows four forces acting on point *P*. What is their resultant? Lay the vectors end to end in any order (as at *B* or *C*) but with the arrows all going in the same direction. The resultant is the line drawn from the tail of the first to the point of the last. It is the single force that is equivalent to the group.

One more step will bring us to a principle used widely in figuring the stresses in framed structures: A joint in a framed structure has no acceleration, so the forces acting on the joint must add up to zero. That means that the arrows representing these forces must form a closed polygon with the tip of the last arrow touching the tail of the first.

This knowledge generally makes it easy to figure the unknown forces at a joint from the known forces. The jib crane, Fig. 5, is a simple case. Three forces act on point *P*: a downward force of 5000 lb, the horizontal left push of the beam (amount unknown) and the pull of the rope (amount unknown) slanting up to right. Placed end to end, these three forces must make a closed triangle; that shown is the only one possible. The unknown forces are scaled directly from the triangle.

Exactly the same method is used in Fig. 6. The ropes pull on point *P* and the gin pole pushes on the same point. The triangle shown is the only one that can be drawn to show the known conditions.

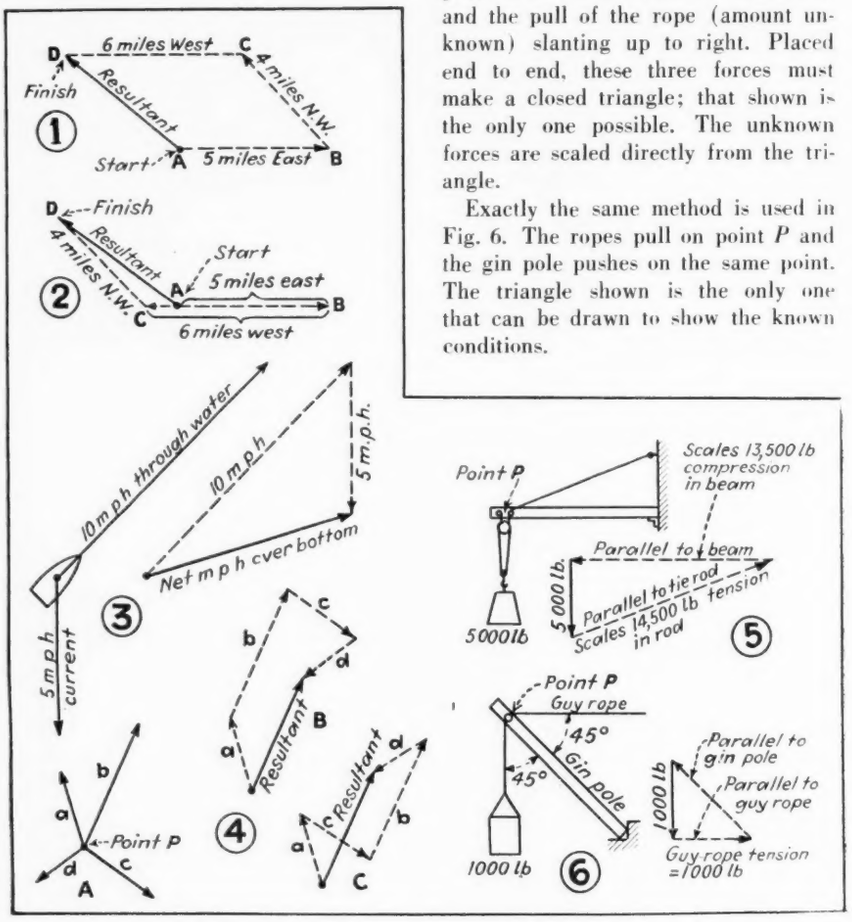


Fig. 1—Man walks *A,B,C,D*. The *resultant*, or net result of his wanderings is represented by the straight line *A D*. All types of vectors are "added" in this manner. Fig. 2—If the steps of Fig. 1 are added in a different order, the result is not changed. Fig. 3—Velocity vectors are added in the same way. Place arows end on end, all running in the same sense. Resultant is line drawn from beginning of first arrow to point of last. This resultant vector shows both the amount and direction of the velocity of the boat over the bottom. Fig. 4—Forces *a,b, c,d*, (all in the same plane) act on the point P. To get the resultant, place the vectors end on end in any order (but don't change their directions). Line drawn from beginning of first arrow to point of last is the resultant, the single force equivalent to the group. Note that the different order in *C* gives the same result as in *B*. Fig. 5—Diagram shows forces acting on point *P*. Weight pulls straight down. Rope pulls back in direction of its length. Beam pushes left in horizontal direction. Completing triangle as shown permits scaling tie-rod tension and beam compression. Fig. 6—With gin pole at 45 deg and guy rope horizontal, guy-rope tension equals load (1000 lb)

ARGUMENT CORNER

Parallel Pump Operation

IN THE OCTOBER ISSUE of POWER you published the answers to the July Question No. 1 and the consensus seems to be that the two pumps work all right in parallel at heavy load but that at light load one of the pumps draws all of the water, robbing the second pump of its prime. This is attributed to insufficient head or an undersized suction line. However, a little reflection should convince any one that that explanation cannot be supported. That is, if the pumps work all right at full load then there must be sufficient head and the suction pipe size must be ample, because at partial load the head required and pipe size needed will be smaller.

Although all or most of the writers seem to be of the opinion that the pumps fail to work properly in parallel at low load, that is not what BFD stated in his question. He simply stated that "as the load changes" the pumps failed to work right.

As a matter of fact, it is my opinion that it is at heavy load when one of the pumps loses its prime and begins to short-stroke. Such a conclusion will follow the assumption that the head is not sufficient or that the suction is too small. We can assume that the two pumps, at the time they were installed, were not intended to be used together; rather, one pump was intended as a standby, and naturally the suction-pipe capacity was sufficient for only one pump to operate at a time.

My advice to BFD is to check the condition of the pumps as to piston packing, water valves, and steam-valve setting and then try using only one pump even during the heaviest load. If it is definitely established that one pump cannot handle the peak load, and if when using two pumps, one loses its prime, then that would be sure proof that the suction pipe is too small or the head not sufficient.

Chicago, Ill. N T PEF

Has His Own Simplified Level

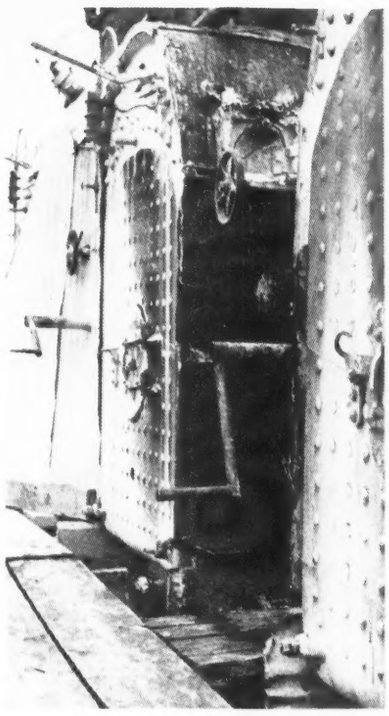
THE ARTICLE, "Micrometer Simplifies Leveling Job," by R Boettinger in the November number, interested me because I have added a standard 6-in. steel machinist gage to a 2-ft steel level, as in the drawing. The gage is held in place by four flat-head screws threaded into the end of the level. When using the gage to measure the amount off level, the screws are adjusted so that it moves with considerable resistance. This permits easy adjustment, to put the level in a horizontal or vertical position, but at the same time the gage will remain at the adjustment.

Mr Boettinger mentions using the level and micrometer for leveling overhead beams. The micrometer or the gage is a very useful attachment for this work. I have also found the gage handy for checking the level of machine bedplates and shafting, to get the slope of pipe lines and for other purposes.

Philadelphia, Pa. R W HAINES

Crank Control for Blowoff Valves

THE ARTICLE, "Blowdown Control at Boiler Front," by Gilbert M Wilson, in August number, brings to mind an experience of my own. We were operating two temporary boilers under rather rough and ready conditions where the feedwater was of such poor quality that frequent blowdown was necessary. To



permit the fireman to operate the blowdown valves from the front of the boilers we provided them with extended cranks, as in the photo.

From the cranks, which are made of pieces of pipe welded together, we ran a 2-in. pipe, supported in brackets from the front of the boilers back to the blowoff valves. With the welding torch, two short pieces of 6-in. pipe and some steel plate, we made two pulleys for each boiler. One of each pair we welded in place on the 2-in. pipe and the others we attached to the top of the plug blow-off valves. Each pair of pulleys was then connected by a piece of chain

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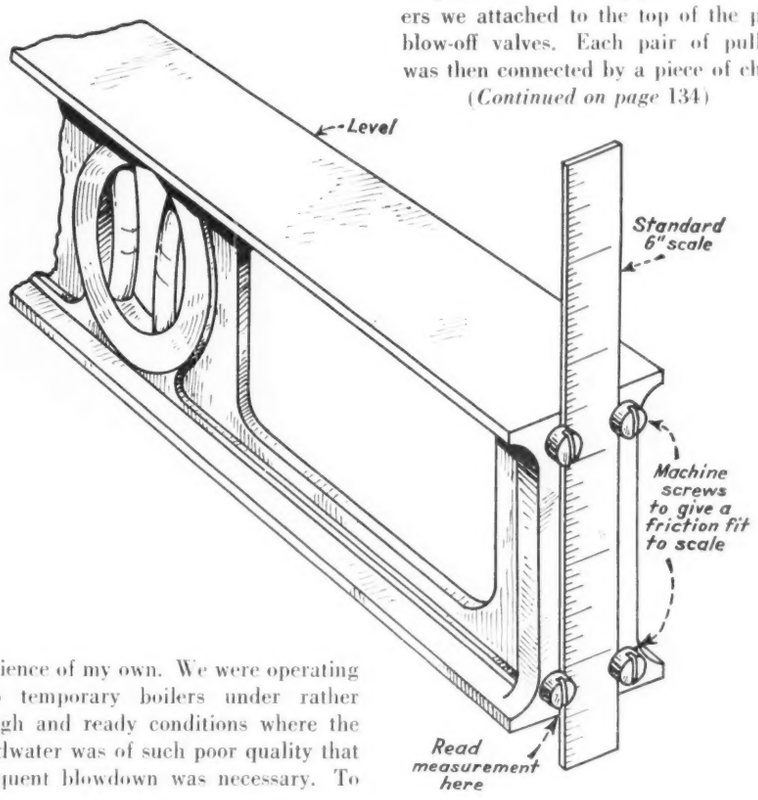
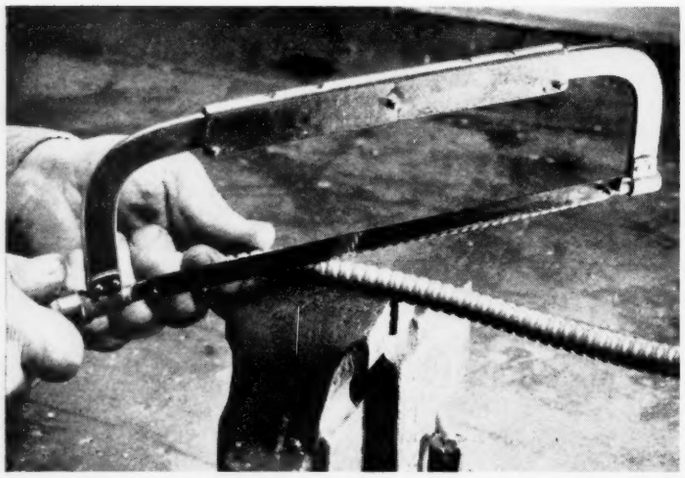


HOW TO CUT ARMORED CABLE

FLEXIBLE ARMORED ELECTRIC CABLE finds many industrial power applications, particularly where it is difficult to install rigid conduit, or where a certain amount of flexibility is necessary between the conduit system and the connected apparatus. In the installation of this cable one of the important operations is cutting the armor, either to sever the cable or to remove a section at the ends to expose the conductors. Unless care is taken to get this part of the installation work done correctly it may lead to insulation failures and other troubles later. This operation, however, is easily performed if a few simple rules and practices for doing the work are followed.

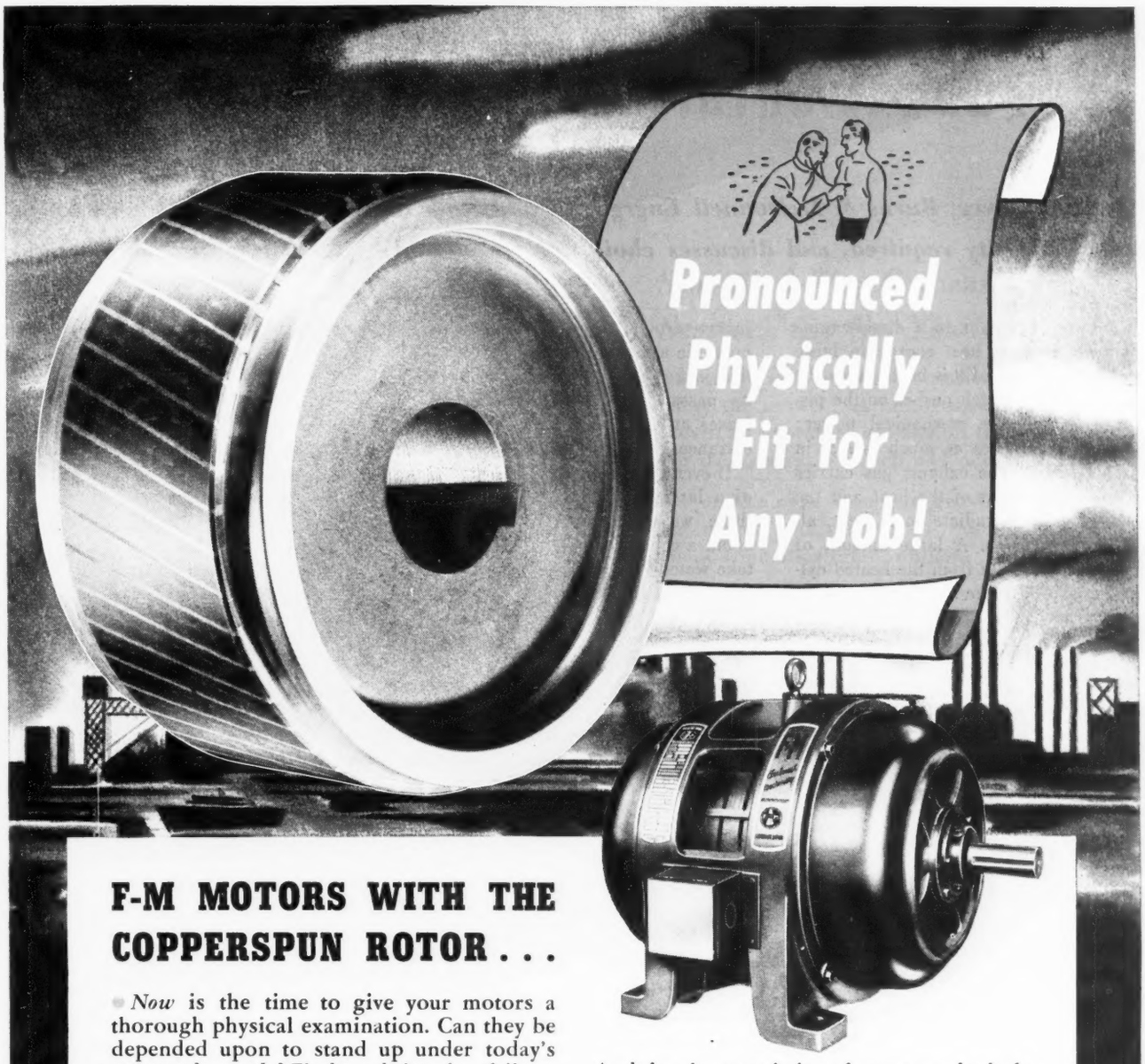


1 To cut the armor, place it on some solid object, if possible, and with a hacksaw cut one convolution of the armor. This cut should be made at an angle of about 30 deg with the axis of the cable. When doing this, hold the cable in the left hand and operate the saw with the right. Never cut armored cable left-handed or it will result in a sharp needle point of steel at the end of the cut convolution

3 After removing the armor from the ends of the conductors, hold the armor on the cable with the left hand and with the right insert a fiber bushing between the paper sheath around the conductor and the armor. This is necessary to protect the insulation on the wires against injury on any rough edges that may be left at the cut. If care is not taken insulation on the wire can be easily injured at this point

2 After the cut is made, grip the armor firmly with one hand on each side of the cut. Twist the armor by turning the left-hand clockwise and the right counter-clockwise so as to open the cut. This will tend to increase the internal diameter of the armor and will cause it to part at the cut, after which the short end can be pulled off quite easily

4 When the paper wrapper is removed, bend the conductors back over the end of the armor to prevent it from creeping down over the conductors. If desired, the paper wrapper need not be removed until after the cable has been installed. Some armored cable has a thread under the paper wrapper that is pulled to slit the paper before removing it



F-M MOTORS WITH THE COPPERSPUN ROTOR . . .

Now is the time to give your motors a thorough physical examination. Can they be depended upon to stand up under today's greater demands? Find out *before* they fail . . . *before* they cause expensive delays.

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Fundamentals of Diesel Cooling

Glenn C Boyer, Burns & McDonnell Engrg Co, shows how to figure heat to be removed and water quantity required, and discusses choice of temperature rise and outlet temperature

▶ BURNING FUEL OIL in a diesel-engine cylinder releases heat energy in large quantities. Some of this heat causes the gas expansion which pushes on the piston and produces mechanical power; almost three times as much is *lost* in various ways. The exhaust gas carries away a large part of the heat and the engine surfaces radiate some heat, although not much. A large amount of heat flows directly from the heated cylinder space into the surrounding walls.

If the cylinders had no water jackets, heat would flow into the cylinder walls faster than the sluggish outside air currents could remove it. As a result, they would become excessively hot. To keep metal temperatures to a point where trouble-free operation can be maintained, it is customary to put a water jacket around the cylinders and to maintain a steady flow of water through this jacket. The water absorbs heat in its passage from inlet to outlet and leaves at a temperature above that of entrance.

If every engine operated within reach of a large supply of cool, soft water, there would be nothing complicated about a cooling system. A pump would take water from the source and force it through the jackets, to be wasted or returned to the source. In most cases, no satisfactory supply exists; the water is re-used or re-circulated and means are found to cool the water after passage through the engine. If heat at low temperature can be utilized, the heat removed from the engine by the jacket water can be taken from the water, and put to work. Where this is not possible, the heat must be dissipated.

The first step in considering a cooling system involves figuring how much heat must be removed by the jacket water. The percentage of total heat which finds its way into the cooling water varies considerably for different makes and types of diesel engines. Most designers follow the approximate rule given in "Standard Practices", Diesel Engine Manufacturers' Assoc, which says "an average of 3000 Btu per bhp hr is an approximation which may be used for the amount of heat rejected by an engine to the cooling-water system."

In most cases, the manufacturer will give a figure that can be used with

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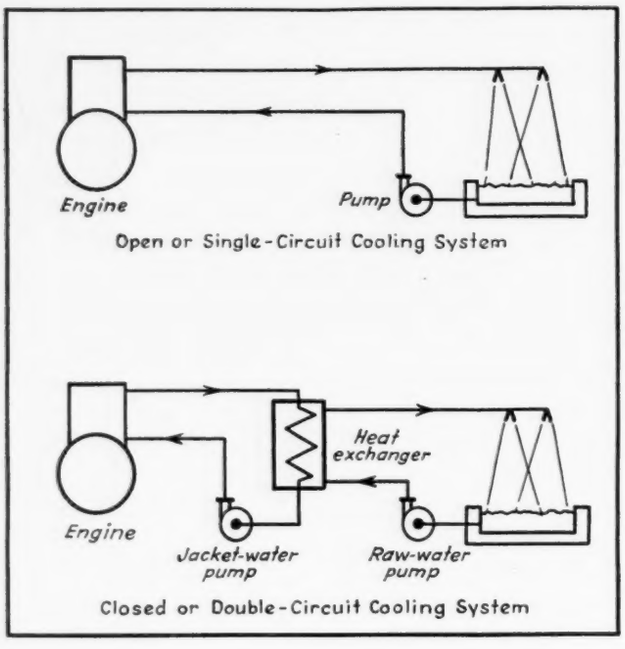


Fig. 1—Typical open or single-circuit cooling system and closed or double-circuit system. Cooling systems employing air-cooled radiators have only one actual circuit, but this is closed and gives the same advantages as a double circuit

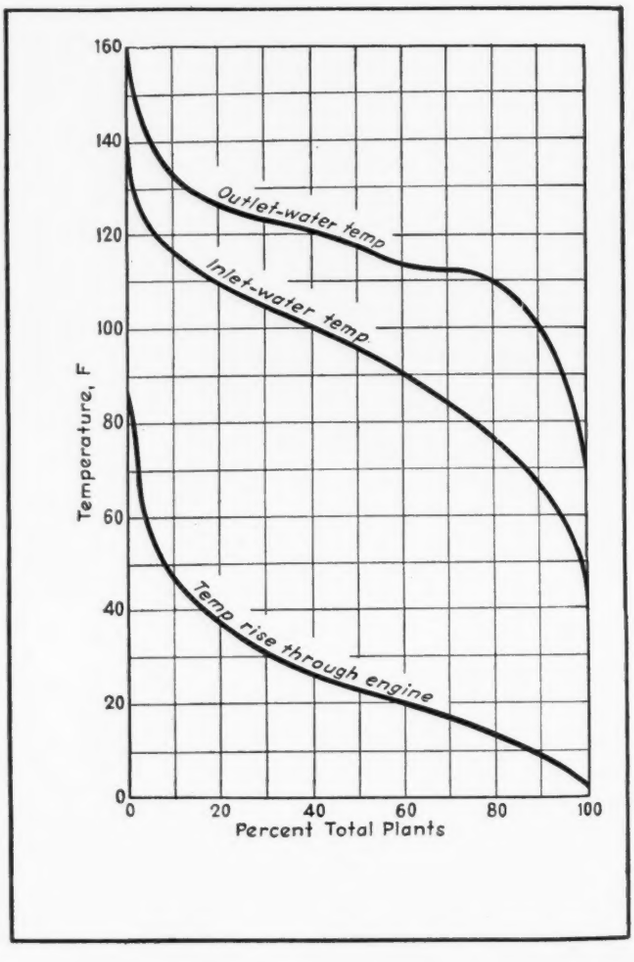


Fig. 2—Data on temperature rise and inlet- and outlet-water temperatures, based on figures reported by 145 plants included in the ASME "Oil Engine Power Cost Report, 1939"

TWO YEARS LONGER TUBE LIFE

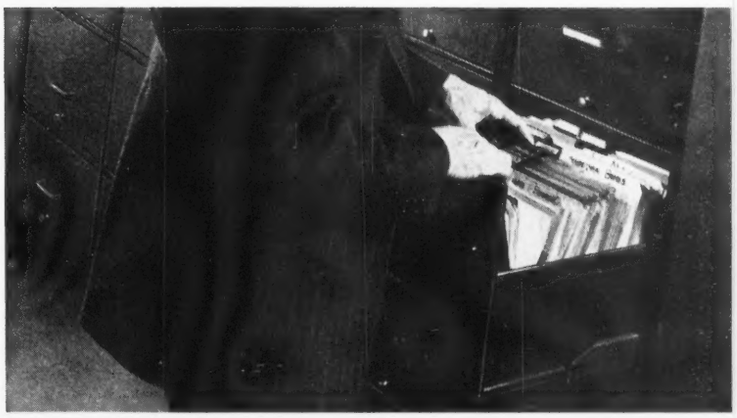
FOR STATION No. 4

. . . Scovill's 3-Way Condenser Tube Service May Get You Similar Results

Tube deterioration was swift at Station No. 4. Was another tube alloy the answer? A minor mechanical change? Or was Scovill's Laboratory already on the way to an answer through its constant research and development of alloys?

Pictures on this page show how Scovill's three services . . . in *men, metals* and *manuals* . . . go into action to solve customers' condenser tube problems.

MEN—At Station No. 4, tube deterioration had set in very rapidly on the outside of the tubes near the tube sheet. Tube samples were thoroughly studied at Scovill's Laboratory. Tests proved nothing wrong with the present alloy, but a change in tube installation was recommended and acted upon. Service life has been very satisfactory ever since.



MANUALS—The installation method so successfully applied in the situation above . . . and important data on all Scovill's tube material are contained in a new "Condenser Tubes" booklet . . . free for the asking and part of Scovill's Service in Manuals. Write Scovill Manufacturing Company, 13 Mill St., Waterbury, Conn.

METALS—Pictured here are the experimental furnace and mold which produced the first heat of Scovill's patented "Phosphorized Admiralty" tubing alloy. This was in 1939 . . . since then a remarkable sales record for this alloy has resulted . . . several millions of pounds sold . . . only one complaint, and that was a case of misapplication of the material.

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When deliveries are not as prompt as our customers desire we hope they will realize that delays are sometimes unavoidable and part of the price paid for national defense.

Masters of Metal

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

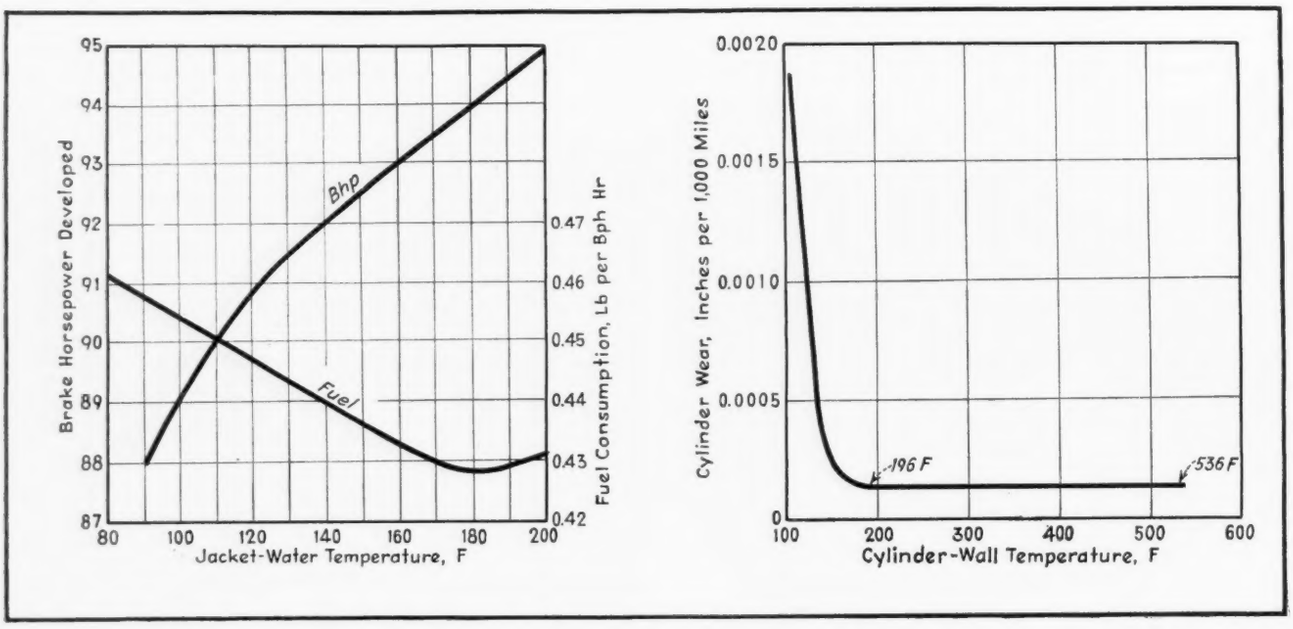

Fig. 3—Use of high-temperature cooling improves performance and reduces cylinder wear, according to some authorities. The curve at the left comes from "High-Speed Diesel Engines," by Arthur W Judge, while that at the right comes from "Collected Researches on Cylinder Wear", published by the Institution of Automobile Engineers, Great Britain

confidence. Where such information is not available, the following empirical formula will yield reasonable results if the fuel consumption is known:

$$Q = \frac{(19{,}350 \times F) - 2545}{2}$$

where Q is the heat rejected to the cooling system, 19,350 is the average heating value of diesel fuel oil, and F is the fuel consumption, in lb per hr. The formula is based on the fact that, for most engines, the heat lost to the cooling water, at full load, represents about one-half of the total heat lost.

Lube-Oil Cooling

If the jacket water is used to cool the lubricating oil or to cool the exhaust manifold by means of a water jacket, these quantities of heat will also have to be considered. Cooling lube oil means that another 700-900 Btu must be absorbed by the jacket water, per bhp hr, and a water jacket on the exhaust manifold will add another 200 Btu or more.

So much for the amount of heat to be removed by the cooling water. How much water will be needed? We know, by the definition of "Btu", that one lb of water will absorb 1 Btu if the temperature rises 1 F. Likewise, the same pound of water will absorb 10 Btu if the temperature rises 10 F. Thus the amount of water required depends on the rise in its temperature; if a large rise is permitted, little water is needed and if the temperature rise must be held down, large quantities of water are needed. How the permissible temperature rise is arrived at will be discussed later.

The simple relationship outlined above can be put into a formula:

$$Q = W(t_2 - t_1)$$

where Q is the amount of heat absorbed by the water, W is the weight of the water and t_1 and t_2 are the original and final temperatures respectively. If we substitute t, meaning the temperature rise, for $(t_2 - t_1)$, which is the same thing, we get an even simpler formula:

$$Q = Wt$$

Because the water *flows* through the engine jackets in a continuous stream, we have to consider *time*. The above formula will fit any period of time but it is customary to figure in terms of one hour (we have already figured the amount of heat to be absorbed in terms of Btu per brake hp, per *hour*). If we use the amount of heat, Q, in Btu per bhp hr, we must find the water flow for the same period of time. Because water flow is generally given in terms of gallons per minute (gpm) it would be desirable to revise the formula so that gpm could be inserted directly. A gal of water at 60 F weighs 8.345 lb and a flow of 1 gpm is equivalent to 60 gal per hr so that 1 gpm is approximately equal to 8.345 × 60 or 500 lb per hr. Thus, in the formula, W, which is lb per hr, must be divided by 500 to get gpm, or $W/500 = \text{gpm}$. This is the same as saying $W = 500$ gpm; if we substitute this in the equation we get:

$$Q = 500 \text{ gpm } (t)$$

which can be re-arranged to give water flow directly:

$$\text{gpm} = \frac{Q}{500\ t}$$

POWER Data Sheet No. 112, on page 126 of this issue gives a simple graphical method of solving this equation, which will save time when several combinations of water flow and temperature rise must be compared.

Jacket Temperature

Note that up to this point the actual temperature of the water entering the engine jackets hasn't entered the picture. Once the amount of heat to be removed is known, the right combination of water flow and temperature rise can be determined. If the temperature rise is to be 10 F, it will be the same regardless of whether the water enters the jackets at 70 or 170 F. For all practical operating conditions the temperature of the water entering an engine bears no relation to the increase in temperature of the water passing through the engine.

Before seeing what determines the

(*Continued on page* 116)

Stone QUARRY...

IN A SIX-INCH PIPE

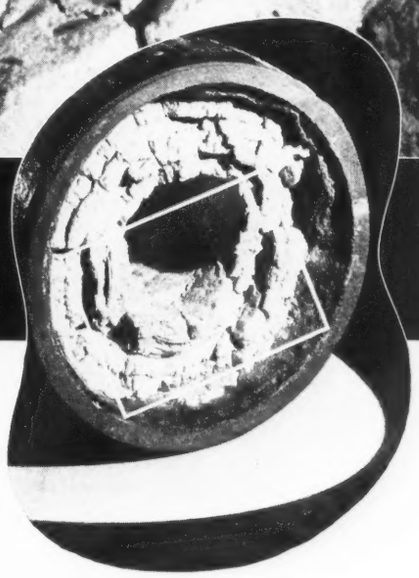

Photo in Nalco Laboratories.

(Large illustration is enlargement of area within white rectangle in inset photo.)

MINIATURE "stone quarries" inside water pipes are expensive and unnecessary. The line from which the typical section pictured here was taken was long ago cleaned *while in service* to full inside diameter by the Nalco System — And is being *kept* clean in the same way.

Where unstable water must be piped . . . hot or cold . . . for steam, processing or drinking — Nalco Engineers have tested treatments that *permanently* end corrosion, incrustation and other unsatisfactory water conditions. Investigate the Nalco System for complete, economical water treatment service in your plant.

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— the Complete Water Treating Service

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Fundamentals of Diesel Cooling

(Continued from page 114)

permissible temperature rise and the desirable entering temperature, it would be well to consider, in simple terms, the basic kinds of diesel cooling systems, since it has a bearing on the matter. In the simplest case, a pump takes water from a river, lake, well, or other source, and forces it through the engine jackets. The water absorbs heat in its passage and then, at higher temperature, goes to waste. Such an arrangement has two drawbacks: (1) it can be used only where large quantities of water are cheaply available, and (2) if the water contains scale-forming impurities, deposits in the jackets will be troublesome since it would be uneconomical to treat the large volume of water passed through an engine and wasted.

By installing some device to cool the water after its passage through the jackets, the same water can be used over and over again, eliminating the waste associated with the "once-through" arrangement. In most cases, the cooling device works on the evaporative principle (cooling towers, spray ponds, surface ponds, etc). The evaporation of a small amount of the water cools the remainder. However, the water evaporated must be made up by adding raw water, and the effect is to constantly increase the concentration of impurities in the system. Since the water is recirculated, treatment is not out of the question economically but is often dispensed with to avoid complication.

Closed Circuit Avoids Scale

Scale formation can be largely eliminated by making the circuit containing the engine jackets a closed circuit. Thus the only makeup required is for possible leakage and, if the jacket circuit is filled with soft water to start, there should be no scale troubles. The difference between a single- and double-circuit cooling system is shown in Fig. 1. Although only one water circuit is involved, systems using air-cooled radiators achieve the same results as double-circuit systems, since the jacket circuit is entirely closed.

In actual practice, entering and leaving temperatures, and temperature rise vary considerably. Fig. 2 shows data from 145 plants reporting to the ASME for the "Oil Engine Power Cost Report, 1939". Inlet temperature varied from 40 to 140 F, outlet temperature from 70 to 160 F, and temperature rise from 5 to 85 F. The figures on inlet water temperature are quite scattered, but the largest group of operators (22%) hold to 100-110 F while almost two-thirds keep inlet temperature at 90 F, or higher. The temperature-rise figures are more consistent, with more than half the operators running at 10 to 30 F rise and more than two-thirds at less than 30 F rise.

When these data are divided between plants with single- and double-circuit cooling systems, there appears to be a distinct tendency for higher water temperatures to be used only with double-circuit systems. In fact, 64% of the stations reporting leaving temperatures in excess of 120 F employed double-circuit cooling systems. Although practically equal numbers of each type of system were included in the plants reporting, the single-circuit systems were largely restricted to plants with lower water temperatures.

Temperature Trends

The present situation with regard to temperatures seems to be a slow evolution from the past. When single-circuit cooling systems were almost universal, it was found advisable to keep jacket-water temperatures low to avoid severe scale formation, the tendency toward which increases markedly as water temperature rises. The advent of the double-circuit system removed this limitation and led to a cautious increase in temperatures. For many years it has been felt that the maximum temperature of water leaving an engine should not exceed 120 F for a single-circuit system and 140 F for a double-circuit system with softened or scale-free water in the jacket circuit.

If no limitation is placed on the jacket-water temperature by scale problems, the maximum temperature must be arrived at by judgment and experience with a particular design. Higher metal temperatures mean greater expansion and likewise higher lubricating-oil temperatures. For large, slow-speed engines, designers have sometimes used an empirical formula for the temperature leaving the jackets:

$$t_2 = 190 - 4D$$

where t_2 is the leaving temperature and D is the cylinder diameter, in inches. Many builders of large, slow-speed engines set an upper limit of 140 F and in some cases, particularly with engines of 2000 hp and larger, the limit is set at 120 F. On the other hand, several engines in stationary service have operated with outlet temperatures of 175 and 180 F and experience has been entirely satisfactory.

Experiments with higher jacket-water temperatures have been largely confined to small high-speed diesel and gas engines. As a result of these experiences, the following advantages are claimed for "high-temperature" cooling: (1) improved engine performance due apparently to higher mechanical efficiency resulting from decreased oil drag and cylinder distortion, (2) decreased liner wear, and (3) better heat-recovery possibilities, including recovery of all waste heat as 1-p steam.

Perhaps the most important possibility in use of higher jacket temperatures lies in reduction of liner wear. While the major cause of liner wear is still strongly debated, a considerable number of authorities put corrosion high on the list as a source of trouble. When fuels containing hydrogen burn, water is formed. This exists as a vapor unless it comes in contact with a metal surface at a temperature below its dew-point. If this happens, the vapor condenses, leaving a trace of moisture on the surface. If the fuel contained sulphur also, the sulphur gases formed in combustion will combine with the moisture to form sulphur acids, even more corrosive than the water alone. Thus low jacket-water temperatures, and consequently low metal temperatures at the bottom of the cylinder, may cause condensation and resulting corrosion.

Vapor-Phase Cooling

High-temperature cooling by the "vapor-phase" system, in which the jackets are carried under pressure and water temperature may run up to about 240 F, has been tried with considerable success on gas engines in the West. Results of these trials and discussion of the various factors involved will be found in POWER, July and Aug, 1941.

For obvious reasons, the operator should follow the instructions laid down by the manufacturer of his engine in regard to water temperature, and should also follow the generally accepted practice of holding the temperature rise to less than 20 F. Recent developments in use of higher jacket temperatures indicate a possible trend in this direction, and also indicate the wisdom of erring on the high side rather than the low in choosing an operating temperature.

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Quick Motor Change Prevents Water Shortage

When 25-cycle power curtailment threatened, 32 large motors and deepwell pumps were changed to 60-cycle operation in 42 days

By JOHN C REDD
Westinghouse Electric & Mfg Co

▶ WHEN A SHORTAGE of 25-cycle power occurred because of drought in an Arizona irrigation district in the spring of 1940, a quick changeover to 60-cycle Boulder Dam power permitted the district to maintain its normal pumping capacity. Electric motors and pumps at 32 of the 51 pumping stations operated by the Roosevelt Irrigation District of Tolleson, Ariz., were changed from 25- to 60-cycle operation in 42 days.

The district received 25-cycle power from a power company at 33,000 volts, 3 phase. Each well had its own pump, motor, control and bank of transformers which stepped voltage down to 440. Pumps were all deepwell turbine units, direct-connected to vertical, solid-shaft, 3-phase, 25-cycle, 720-rpm, 4-pole squirrel-cage induction motors.

As pump characteristics had a definite bearing on what change could be made in the motors, the pump manufacturer was consulted as to what could be done to suit the equipment to 60-cycle operation. It was decided to rewind the motors for 6-pole, 3-phase, 60-cycle, 440-volt operation, and change the pump bowls. By choosing the 6-pole speed, good motor performance with increased horsepower was obtained to utilize the increased capacity and improved pump performance made possible by the new bowls.

It was imperative that the change be made as quickly as possible, to permit power reduction on the 25-cycle system and thus to avoid interference with the growing crops. As the available 60-cycle supply was sufficient for 32 motors, they were all that needed to be changed. One additional motor, however, was changed, to serve as a spare. In this group there were nine 150-, twenty 100- and four 75-hp motors. After rewinding, these motors were good for 200, 125 and 100 hp respectively.

One complete 100-hp, 25-cycle motor was delivered to the Los Angeles service department of Westinghouse Company where a new 125-hp, 60-cycle winding was designed, made and installed. After a commercial test, the motor was sent to the Peerless Pump Co plant for an overall test on the pump with new bowls. This test proved the accuracy of the calculations, permitting final arrangements for an early completion of the changeover.

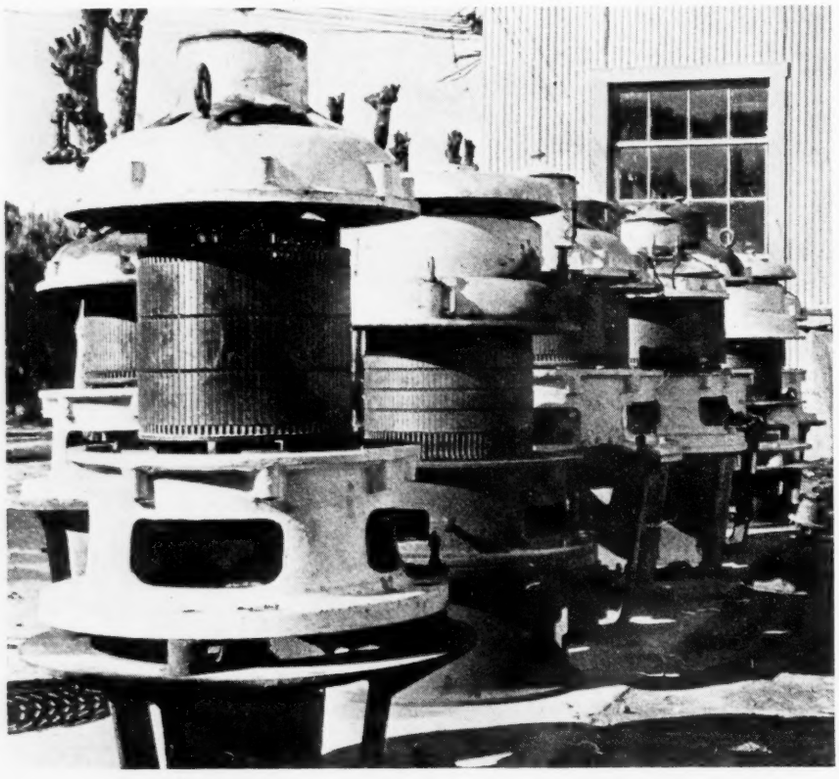
Streamlined Activity

The activity then was streamlined for speed. Pump parts were manufactured in the Los Angeles plant of the Peerless Pump Co and shipped direct to the Irrigation District. Motor and control coils were made in the Westinghouse Service Department at Los Angeles. As each set was made, it was boxed and shipped to the Irrigation District, with the necessary slot insulation, connectors, wedges, line leads and new nameplates. Each box was marked with the motor rating and motor location. While the coils were being made, the motors were removed from the pumps by field crews and delivered to the district shop, where they were stripped and rewound.

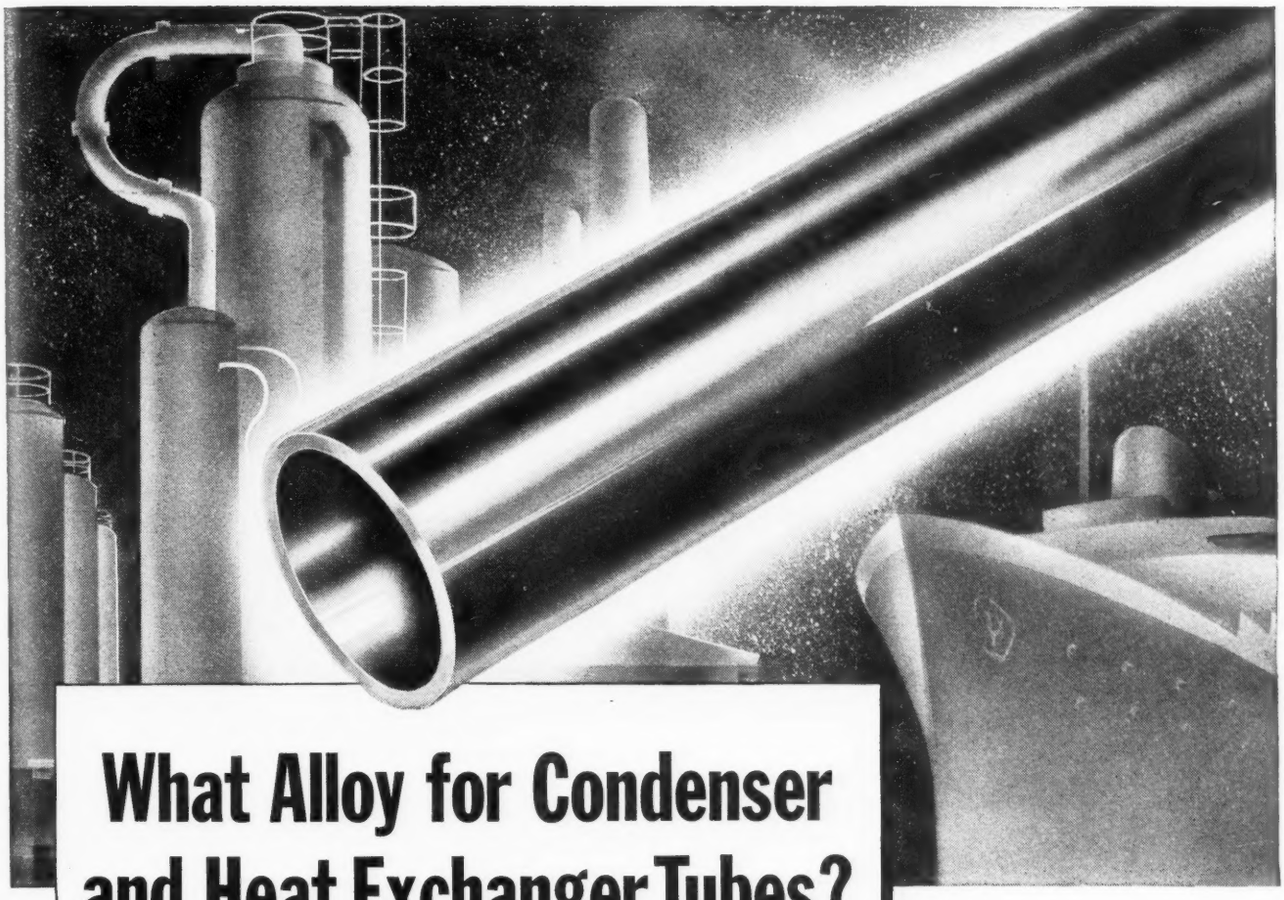
No work was done on the 25-cycle transformers, as they were suitable for the 60-cycle requirements for the present. Motor controls were made useable by either rewinding the 25-cycle coils for 60 cycles, or replacing them with new 60-cycle ones.

The 33,000-volt line formed a ring connecting all the wells. The work was simplified by sectionalizing the line, putting 60 cycles on one end and 25 cycles on the other. As each motor was reinstalled, it could be operated immediately by merely separating the line beyond the 60-cycle motor and connecting behind the motor. The first motor was received in Los Angeles on April 15, 1940. The thirty-second motor went on the line in the field 42 days later.

As a result, irrigation was maintained at 100 % in the areas served by the pumping stations operating with 60-cycle motors. Wells still depending upon 25-cycle power in the Roosevelt and other districts were curtailed from 25% to 50%.



Stators have been removed from these 25-cycle, 75-, 100- and 150-hp induction motors to be rewound for 100-, 125- and 200-hp ratings when operating on 60-cycles



What Alloy for Condenser and Heat Exchanger Tubes?

To obtain maximum service life for condenser tubes there are many operating factors to be considered—character of the cooling water, turbulent flow, and entrained air, to name but a few. Naturally your tube alloy should be selected in accordance with the combination of these factors existent in your plant.

Through their unparalleled experience in the field, Anaconda engineers have accumulated a vast fund of knowledge with which to meet these problems. Their service is available upon request. They can cooperate in analyzing your requirements and place before you performance records of copper alloys under similar operating conditions. No charge is made for such consultation. 41113

The American Brass Company manufactures a wide range of tube alloys for condenser and heat exchanger installations. They are fully described in our latest Condenser Tube Publication B-2, which will be sent upon request.

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Test Shows Small-Unit Efficiency

Pneumatic-spreader stokers in 2000-sq-ft box-header boilers at Wyndmoor, Pa. laboratory of U S Dept of Agriculture register 79.6% efficiency on Bureau of Mines' test

By T A MARSH. *Iron Fireman Mfg Co*

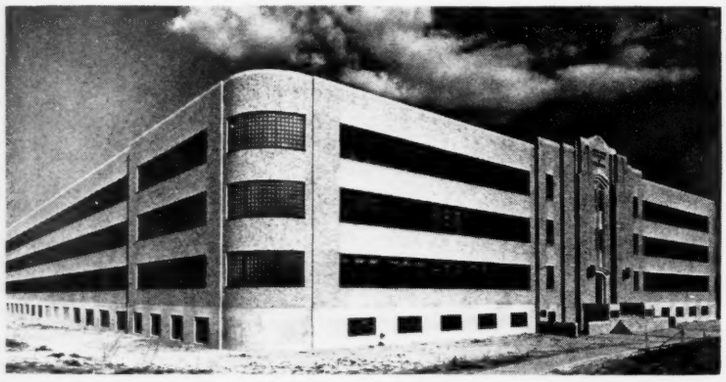

Fig. 1—Wyndmoor, Pa., laboratory of U S Dept of Agriculture, one of six research centers set up under the Agricultural Adjustment Act of 1938. Boiler plant is in a separate building

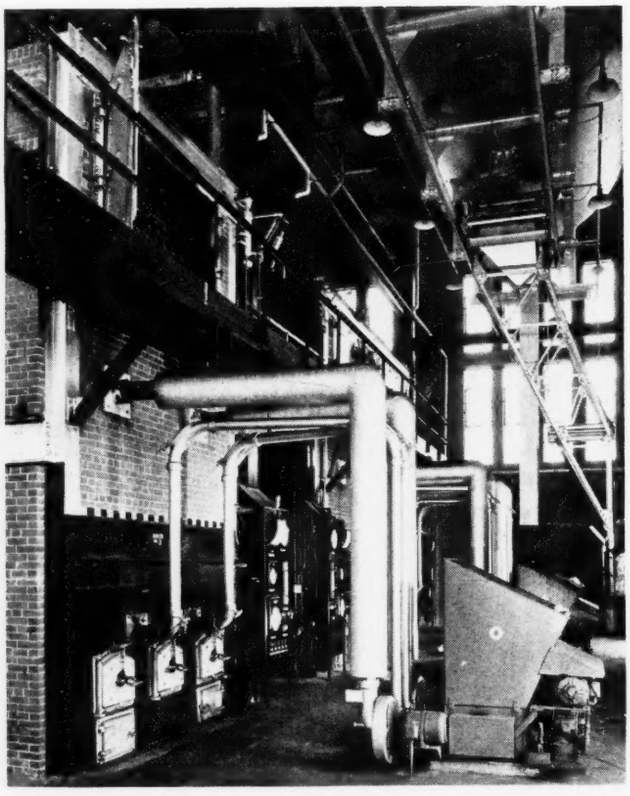

Fig. 2—Arrangement allows plenty of room for operators

▶ RECENTLY the U S Department of Agriculture built six Regional Laboratories, under the Agricultural Adjustment act of 1938. These are decentralized extensions of the Bureau of Chemistry and Engineering, and are located in various agricultural centers. This article describes the power plant at the Wyndmoor, Pa., project, and gives results of a complete boiler test (see also POWER, February 1941, pg 87, for description of meters, control).

Steam is used in the laboratory mainly for space heating, water heating, air conditioning, for operating the house vacuum jet, and the water still. Steam flows through underground mains from the power-plant building to the laboratories at boiler pressure (125 lb g). It is reduced to 100 lb, 30 lb, 15 lb, and 5 lb g, as required. The heating system consists of ten unit air conditioners in conjunction with direct radiation. Condensate returns to the feedwater heater by vacuum-return pumps, and pumping traps.

Fuel comes to the plant in railroad cars, which dump into a track hopper. A bucket conveyor elevates fuel to the bunker, which is 40 ft long and has a capacity of 200 tons, or the equivalent of 20 days' operation. The bunker is lined with 3 in. of gunite, reinforced with steel, and is equipped with five discharge gates. Coal feeds to the stoker hoppers by 1000-lb, hand-operated. Fanning & Schuett traveling weigh larries which receive the coal from the bunker. All coal weights are automatically stamped as coal is weighed.

The 160-lb boilers, built by Titusville Boiler Co. are welded-and-riveted, straight-tube, box-header, single-drum

(*Continued on page* 122)

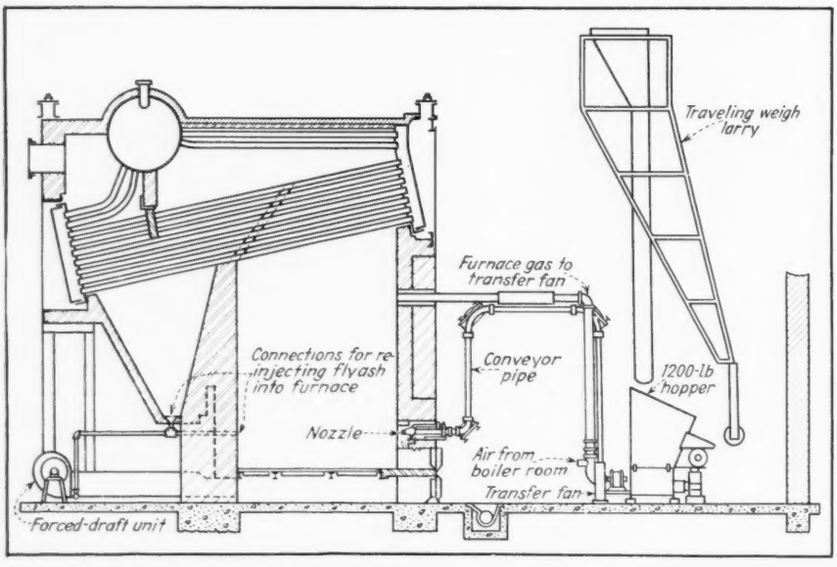

Fig. 3—Air, furnace gas, or both, conveys coal; connection from forced-draft duct used to re-inject into furnace flyash settling in hopper beneath second and third passes

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Test Shows Small-Unit Efficiency

(*Continued from page* 120)

units with 4-in. diameter tubes. Each of the three contains 2000 sq ft of heating surface and is guaranteed for 78% efficiency at 150% of rating. No economizers, water-walls, preheaters, or superheaters are used.

Feedwater is supplied by two 6x4x6-in. reciprocating steam pumps, one motor-driven 70-gpm centrifugal and one turbine-driven 100-gpm centrifugal.

Three 2000-lb-per-hr, Iron Fireman dual-feeder, pneumatic-spreader stokers are installed, each provided with a hopper of 1200-lb capacity, which receives coal from the traveling weigh larry. Each stoker has two feed worms driven by a 1½-hp motor through variable-speed pulleys in combination with a three-speed transmission. The feed worms meter the coal to a transfer housing, from which a gas stream conveys it to the furnace. The fines burn in suspension and the larger pieces form the fuel bed. The nozzles which deliver to the furnace have adjustable tips for distribution control, insuring uniform spreading over the grate area.

Pneumatic Coal Feed

The transfer fan draws air from the boiler room as the conveying stream for the fuel. To handle wet fuel, hot gas can be drawn from the furnace and used alone, or tempered with air, for conveying. Maximum turbulence results because the conveying stream enters the furnace at 90 deg to the forced-draft air through the fuel bed. The stokers are set on a line 12 ft from the boiler front, making a convenient arrangement for supplying coal to the stoker hoppers and leaving the boiler fronts unobstructed and accessible for the usual firing attention.

On each boiler, a Northern Blower Co forced-draft fan discharges into a divided duct supplying the two sections of a zoned plenum chamber. With this arrangement, air can be cut off either zone, allowing one section of the grate to be cleaned while the other is operating. The fans are dual driven, each being connected to a steam turbine and an electric motor. Normally the motors drive the fans.

The Hays combustion-control system consists of a master, sensitive to steam pressure, connected to three air-flow control units. These units balance the master loading against an air-flow loading: impulses from the air-flow control units actuate electric power units which position the forced-draft dampers. On

(*Continued on page* 136)

Boiler and Stoker Test at Heating Plant
Eastern Regional Laboratory, Dept of Agriculture Wyndmoor, Pa.

Item No.		
1.	Test No.	1
2.	Date	July 23, 1940
3.	Duration, hr	9.95
4.	Boiler	No. 3
5.	Type of boiler	Titusville Iron Works Cross-Drum
6.	Type of stoker	Iron Fireman Spreader
7.	Grate surface (approx), sq ft	60.9
8.	Type of fuel	Low-volatile bituminous coal
9.	Boiler heating surface, sq ft	2000
10.	Ratio of heating surface to grate surface	32.8
11.	Combustion-space volume (approx), cu ft	710
	AVERAGE PRESSURES and TEMPERATURES	
12.	Steam pressure by gage, lb per sq in	121.5
13.	Draft—combustion chamber, in. H_2O	−0.099
	—boiler breeching ahead of damper, in. H_2O	−0.057
13a.	Air pressure at stoker grates, in. H_2O	0.52
14.	Temperature of feedwater entering boiler, F	73.9
15.	Temperature of calorimeter, F	295.1
16.	Temperature of gas leaving boiler, F	483
17.	Temperature in coal feeder—right, F	320
	Temperature in coal feeder—left, F	314
18.	Temperature of air in boiler room, F	83.6
	QUALITY OF STEAM	
19.	Moisture in steam, %	0.24
20.	Factor of correction for steam quality	0.99819
	TOTAL QUANTITIES	
21.	Total weight of coal as fired, lb	9313
22.	Moisture in coal as fired, %	2.7
23.	Total weight of dry coal, lb	9062
24.	Total weight of dry ash and refuse from stoker grates, lb	350
24a.	Total weight of dry flyash from collector, lb	117
25.	Ash and refuse from grates, based on dry coal, %	3.9
25a.	Flyash from collector, based on dry coal, %	1.3
26.	Total weight of feedwater, lb	90,123
26a.	Total steam flow (by boiler flowmeter) lb	90,045
27.	Total water evaporated, corrected for steam quality, lb	89,960
28.	Factor of evaporation	1.1854
29.	Total equivalent evaporation from and at 212F, lb	106,639
	HOURLY QUANTITIES AND RATES	
30.	Dry coal per hour, lb	911
31.	Dry coal per sq ft of grate surface per hour, lb	15.0
32.	Water evaporated per hour, corrected for quality of steam, lb	9041
33.	Equivalent evaporation from and at 212F per hour, lb	10,717
34.	Equivalent evaporation from and at 212F per hour per sq ft of boiler heating surface, lb	5.36
	CAPACITY	
35.	Rated boiler horsepower, hp	200
36.	Boiler horsepower developed, hp	310.6
37.	Percentage of rated capacity developed, %	155.3
	ECONOMY	
38.	Water fed per lb of coal as fired, lb	9.68
39.	Water evaporated per lb of dry coal, lb	9.93
40.	Units of evaporation per lb of coal as fired, lb	11.45
41.	Units of evaporation per lb of dry coal, lb	11.77
42.	Analysis of dry gas by volume:	
	a. *Carbon dioxide* (CO_2), %	14.37
	b. *Oxygen* (O_2), %	4.25
	c. *Carbon monoxide* (CO), %	0.02
	d. *Nitrogen* (N_2), by difference, %	81.36
43.	Dry flue gas per lb of carbon, lb	17.64
44.	Dry flue gas per lb of dry coal, lb	14.18
45.	Proximate analysis of coal as fired:	
	a. *Moisture*, %	2.7
	b. *Volatile matter*, %	20.8
	c. *Fixed carbon*, %	69.2
	d. *Ash*, %	7.3
46.	Ultimate analysis of dry coal:	
	a. *Carbon*, %	82.4
	b. *Hydrogen*, %	4.9
	c. *Oxygen*, %	1.4
	d. *Nitrogen*, %	1.3
	e. *Sulphur*, %	2.5
	f. *Ash*, %	7.5
47.	Heating value per lb of dry coal, Btu	14,350
48.	Ash-softening temperature, F	2280
49.	Analysis of dry flyash from collector:	
	a. *Combustible analysis:*	
	Combustible, %	54.3
	Ash, %	45.7
	b. *Sieve analysis:*	
	Retained on No. 16 sieve, %	0
	Retained on No. 30 sieve, passing No. 16 sieve, %	0
	Retained on No. 50 sieve, passing No. 30 sieve, %	3
	Retained on No. 100 sieve, passing No. 50 sieve, %	9
	Retained on No. 200 sieve, passing No. 100 sieve, %	18
	Retained on No. 325 sieve, passing No. 200 sieve, %	19
	passing No. 325 sieve, %	51
50.	Analysis of dry ash and refuse from stoker grates:	
	a. *Combustible*, %	0.1
	b. *Ash*, %	99.9

51. Heat balance, based on dry coal:

	Btu	%
a. *Heat absorbed by boiler*	11,417	79.6
b. *Loss due to heat carried away by steam in flue gas*	575	4.0
c. *Loss due to heat carried away by dry flue gas*	1359	9.5
d. *Loss due to carbon monoxide*	11	0.1
e. *Loss due to combustible in ash and refuse from stoker grates*	1	0.0
f. *Loss due to combustible in flyash leaving boiler (estimated)*	293	2.0
g. *Loss due to unconsumed hydrogen, hydrocarbons, to radiation and unaccounted for*	694	4.8
h. *Total (see Item 47)*	14,350	100.0

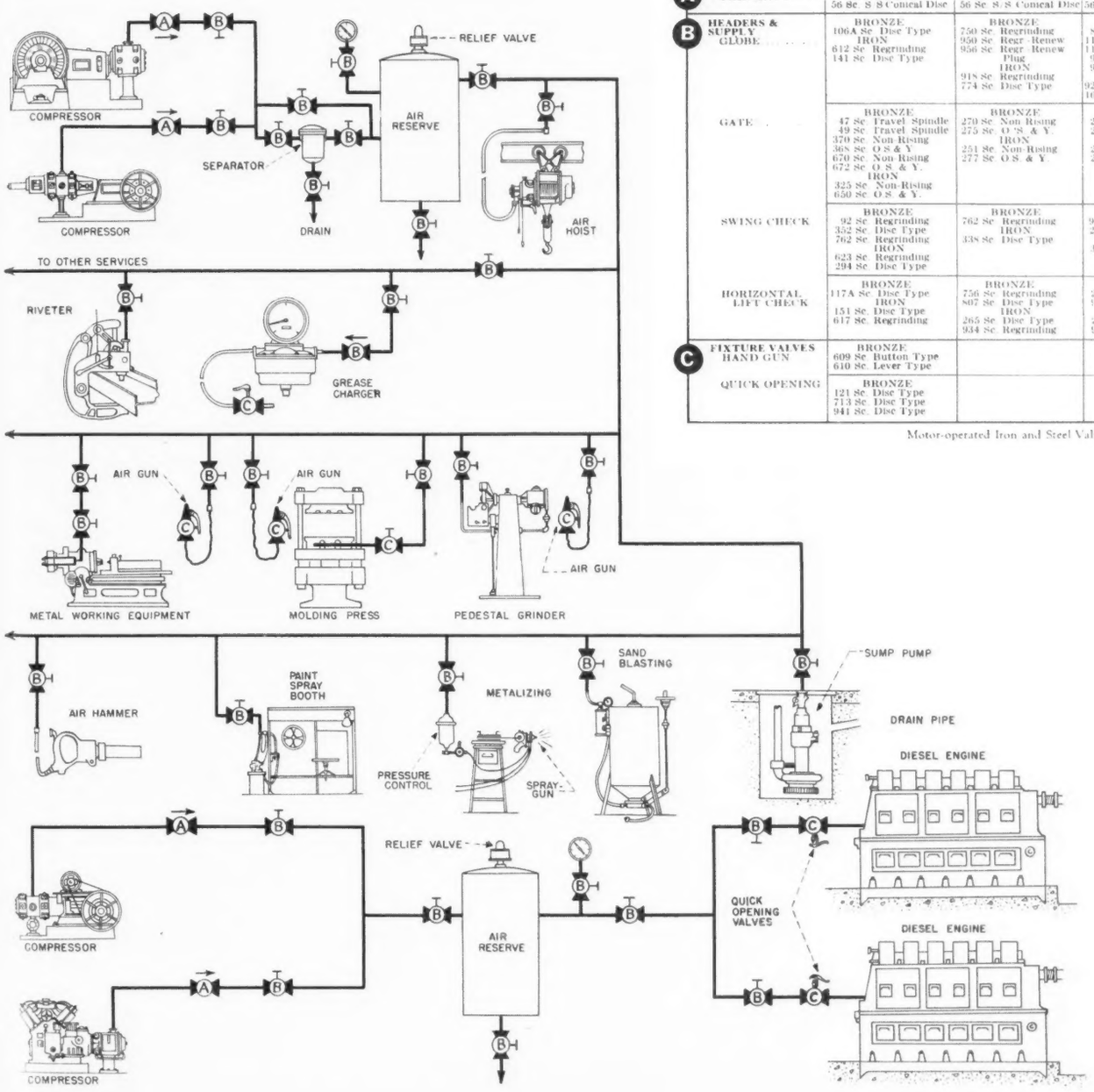
Tubes blown during test at 12:20, 3:15, 5:30.

. . TO GOOD VALVE *PRACTICE* . .

FOR AIR COMPRESSOR SYSTEMS . . .

Jenkins RECOMMENDS . . .

INDUSTRIAL PLANT



REFERENCE CHART FOR JENKINS FIGURE NUMBERS

		Standard	Medium	Extra Heavy
A	AIR COMPRESSOR CHECK	BRONZE 54 Sc. S.-S Flat Disc 56 Sc. S.-S Conical Disc	BRONZE 54 Sc. S.-S Flat Disc 56 Sc. S.-S Conical Disc	BRONZE 54 Sc. S.-S Flat Disc 56 Sc. S.-S Conical Disc
B	HEADERS & SUPPLY GLOBE	BRONZE 106A Sc. Disc Type IRON 612 Sc. Regrinding 141 Sc. Disc Type	BRONZE 750 Sc. Regrinding 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug IRON 918 Sc. Regrinding 774 Sc. Disc Type	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Renew 970 Sc. Regr.-Renew 976 Sc. Regr.-Renew IRON 922 Sc. Regrinding 162A Sc. Disc Type
	GATE	BRONZE 47 Sc. Travel Spindle 49 Sc. Travel Spindle 370 Sc. Non-Rising 368 Sc. O.S. & Y. 670 Sc. Non-Rising 672 Sc. O.S. & Y. IRON 325 Sc. Non-Rising 650 Sc. O.S. & Y.	BRONZE 270 Sc. Non-Rising 275 Sc. O.S. & Y. IRON 251 Sc. Non-Rising 277 Sc. O.S. & Y.	BRONZE 280 Sc. Non-Rising 282 Sc. O.S. & Y. IRON 203A Sc. Non-Rising 204A Sc. O.S. & Y.
	SWING CHECK	BRONZE 92 Sc. Regrinding 352 Sc. Disc Type 762 Sc. Regrinding IRON 623 Sc. Regrinding 294 Sc. Disc Type	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type	BRONZE 962 Sc. Regrinding 260 Sc. Disc Type IRON 338 Sc. Disc Type
	HORIZONTAL LIFT CHECK	BRONZE 117A Sc. Disc Type IRON 151 Sc. Disc Type 617 Sc. Regrinding	BRONZE 756 Sc. Regrinding 807 Sc. Disc Type IRON 265 Sc. Disc Type 934 Sc. Regrinding	BRONZE 263 Sc. Disc Type 966 Sc. Regr. Renew IRON 265 Sc. Disc Type 934 Sc. Regrinding
C	FIXTURE VALVES HAND GUN	BRONZE 609 Sc. Button Type 610 Sc. Lever Type		
	QUICK OPENING	BRONZE 121 Sc. Disc Type 713 Sc. Disc Type 941 Sc. Disc Type		

Motor-operated Iron and Steel Valves can be supplied

NEXT ISSUE: H. P. STEAM SERVICE

 # 36
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Number 112

Diesel Jacket-Water Flow Chart

▶ FOR ESTIMATING cooling-water flow in a diesel-engine water jacket when the water temperature rise is known (or limited by design) this chart gives a quick approximation from either heat dissipated or fuel-consumption rate. Chart is accurate when Btu dissipated per brake horsepower hour is known, but assumes, when using fuel rate, that half the losses occur in the jacket.

For example, an engine with a full-load fuel rate of 0.40 lb per bhp hr can be expected to have jacket losses of about 2598 Btu per bhp hr according to the following formula:

$$Q = \frac{(19{,}350 \times F) - 2545}{2}$$

where

Q = heat to jacket water, Btu per bhp hr

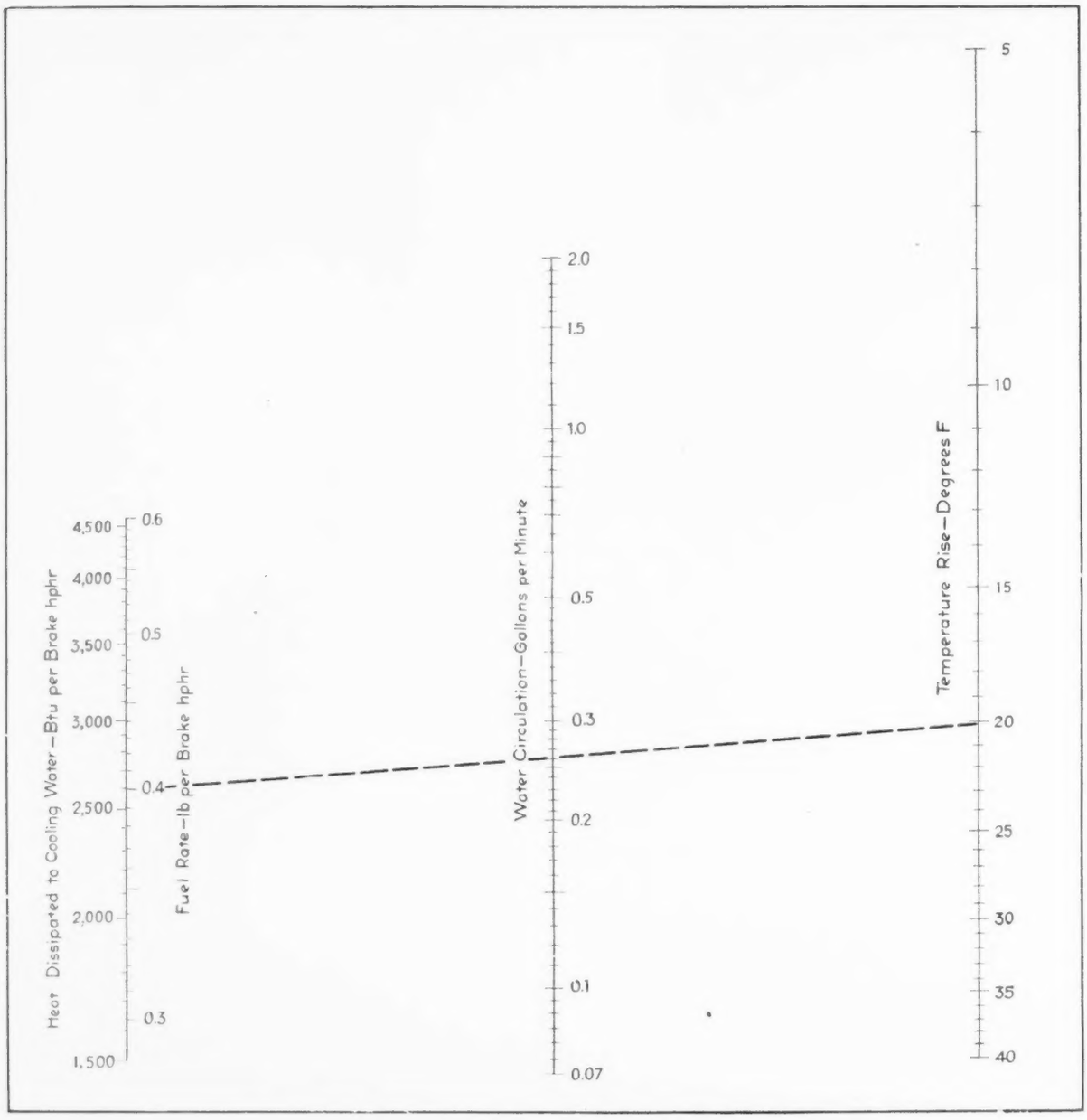
F = fuel rate, lb per bhp hr

19,350 = average heating value of fuel oil as used in ASME Power Test Code for Internal Combustion Engines and new DEMA Marine Standards

2545 = Btu equivalent of one hp hr

This engine would require 0.26 gpm of cooling water per bhp for 20-F rise.

If water is also to be used for lube-oil cooling or a manifold jacket, allow about 700-900 Btu per bhp hr for oil cooling and 200 (or more) Btu per bhp hr for manifold jacketing, depending on exhaust-gas temperature. *Courtesy Glenn C Boyer, Burns & McDonnell Engrg Co.*



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2,000,000

boiler horsepower

No other steam-flow type feed water regulator has ever been accepted so widely, so quickly. You will find installations of the COPES Flowmatic Regulator now in service or on order:

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In 35 states and one territory, and in 15 other countries on four of the five continents.

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On B. & W., Badenhausen, Bigelow, Bros, C-E, Edge Moor, Erie City, Foster Wheeler, Freyn, Lasker, Riley, Springfield, Titusville, Union, Vogt, Wickes and ten other makes of boilers.

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On boilers operating at pressures of from 80 to 1900 pounds gage.

★

On boilers having capacities from 15,000 to 650,000 lbs. per hour.

★

And 40 users have placed 67 repeat orders for COPES Flowmatics—the best known proof of performance.

To be specific . . . in little more than four years, the COPES Flowmatic Regulator has been ordered for 474 boilers with a total steaming capacity of 69,553,250 pounds per hour. And for good reason. The COPES Flowmatic gives remarkably close water level control . . . usually within plus-or-minus one inch . . . regardless of boiler design, pressure or load conditions. Yet the design is so mechanically simple, the construction so rugged, that no more than routine servicing is needed. For complete information on this two-element steam-flow type regulator, write for Bulletin 429.

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Feed Water Regulators, Pump Governors, Differential Valves
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★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW AUTOMATICALLY FLOWMATIC ★ REGULATOR

Operating Methods Must Match Coal Characteristics

How to change handling procedure and pulverized-coal and stoker adjustments to compensate for changes in coal and in operating conditions covered at joint Fuels Conference

▶ AS PART OF A PROGRAM leading to the setting up of a code for testing coal in power-plant use, seven representatives of leading fuel-burning-equipment manufacturers took part in a symposium on the relation between coal characteristics and plant design and operation, at the fifth meeting of the Fuels Division, ASME, and the Coal Division, AIMME, held at Easton, Pa., Oct 30 to Nov 1.

In pulverized-coal-fired plants, coal characteristics affect all operations from the bunker to the ashpit, according to papers by Henry Kreisinger, Combustion Engrg Co; A C Foster, Foster Wheeler Corp; F G Ely, Babcock & Wilcox Co; and Ollison Craig, Riley Stoker Corp; each of whom discussed different aspects of the problem and suggested operating solutions.

Handling and pulverizing are affected by size, moisture content, and hardness of coal. Coal that contains too much fines may hang in the bunker, coal chute or mill feeder; this may be particularly important where coal chutes are long and where slopes are shallow. High moisture content also contributes to hanging. Excessively large coal puts a greater load on mills and may reduce pulverizing capacity, and it is well known that moisture and hardness also reduce mill capacity. Effect of moisture can be minimized by increasing temperature of air supplied to the mill. Fortunately, hard coals are generally high in volatile content and thus do not need to be ground as fine as the softer coals; this tends to increase mill capacity.

Henry Kreisinger starts the session on operation of pulverized-coal units

Moisture and volatile content both affect ignition and burning in the furnace. High moisture delays ignition and makes the fire unstable at low ratings. This can be corrected by use of high-temperature air at the mills, or, in some cases, by adding refractory to radiate heat to the ignition zone. High-volatile coals ignite quickly and burn rapidly because a rich gas mixture is reached sooner than with low-volatile fuel. Reducing primary air proportion will help to obtain the necessary rich mixture when low-volatile coals are burned, but need for sufficient air to carry coal to the furnace puts a limit on reduction of primary air. Use of higher air temperature will give greater air volume for the same weight of air. With extremely low-volatile coals, such as anthracite, a separating burner may be used, which vents part of the carrier air, keeping the air going into the furnace with the coal to the necessary small proportion. The vented air is introduced further down in the furnace, adding to the secondary-air supply. Flame length is regulated by changing the quantity of vented air.

Nature of ash seriously affects pulverized-coal operation. Because ash is not uniform, its behavior in a furnace is not easy to predict. It is becoming increasingly evident that the composition of the ash and the nature of the furnace atmosphere are the most important factors. For this reason, it is necessary to know more than just the fusion temperature to insure proper operation of dry or slagging ash-removal systems and to avoid excessive slag deposits on heating surfaces. Furthermore, the effect of furnace atmosphere on ash action indicates that operators can, to some extent, control slagging conditions by intelligent regulation of excess air. Reducing excess air tends to make slag tapping easier; in dry-bottom units, increasing excess air may diminish fusion and clinkering on furnace walls and screens.

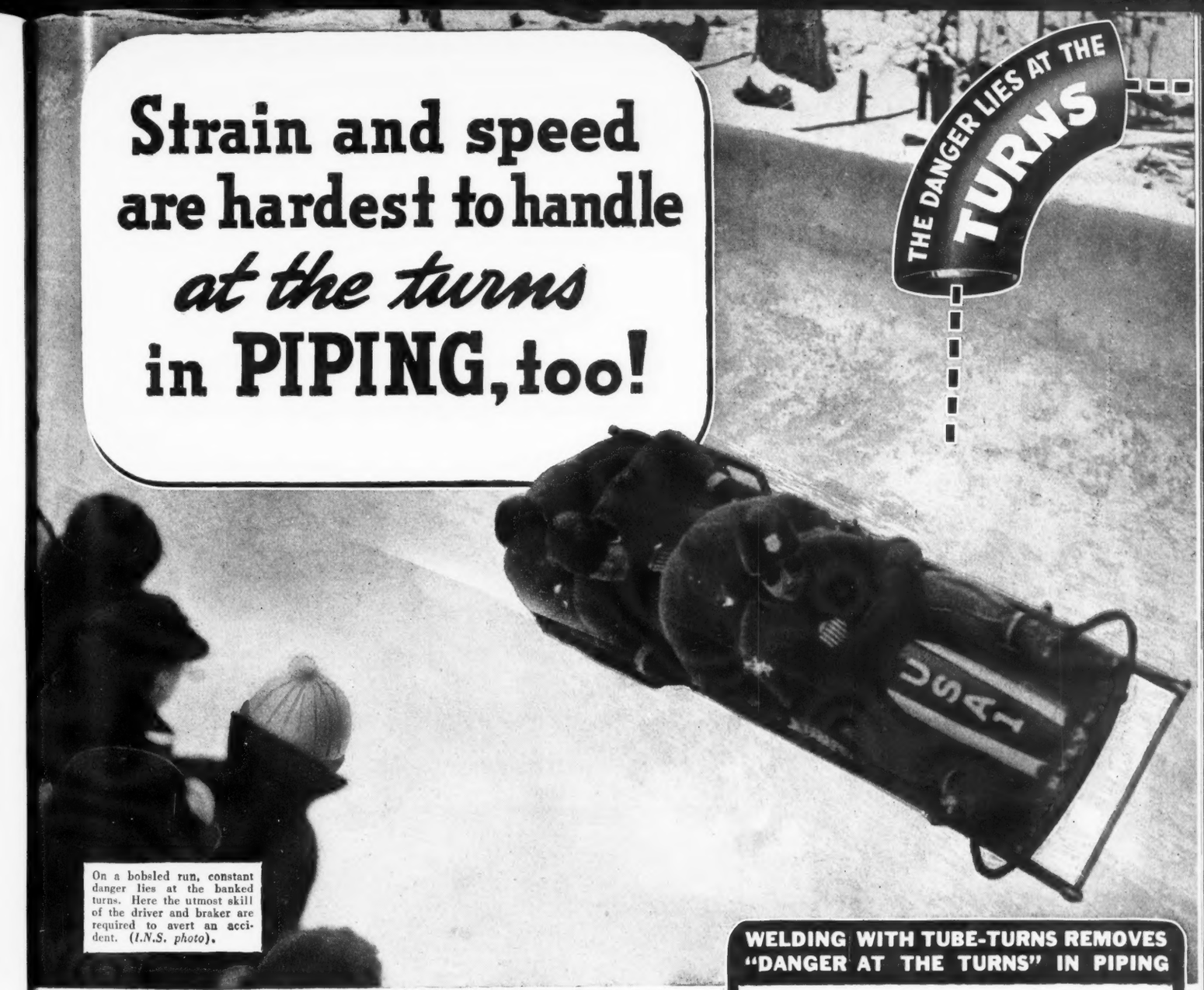
Construction and operating adjustments of underfeeds engages J S Bennett

Discussors pointed out that no mention was made of the effect of coking qualities on pulverized-coal burning and that ignition is a complicated process with time as an important factor. For example, coal will ignite at low temperature in storage piles when ignition time is measured in weeks but on a stoker, where ignition time is in minutes, a higher temperature is needed and in a pulverized-coal furnace, where ignition must be accomplished in fractions of a second, a temperature in the neighborhood of 1100 F is required.

In a session devoted to underfeed stokers and their operation, George P

(*Continued on page* 140)

Strain and speed are hardest to handle *at the turns* in PIPING, too!



On a bobsled run, constant danger lies at the banked turns. Here the utmost skill of the driver and braker are required to avert an accident. (*I.N.S. photo*).

Insure safer, stronger, trouble-free piping systems with TUBE-TURN welding fittings

When the fluids or gases in your piping systems zoom through the lines and swerve into the turns—*added* strain and friction strike the fittings and joints. Trouble usually develops here *first* in any piping system *because the most danger lies at the turns!*

Weld with TUBE-TURN fittings and *your* plant piping systems will last far longer, function more efficiently and safely, save valuable space, and cut upkeep costs.

There is a TUBE-TURN for *every change in flow direction*—elbows, returns, tees, reducers, laterals, nipples and flanges—made with Tube-Turns' exclusive forging process to give unequalled reinforcement at these danger spots.

Get complete facts in the helpful Tube-Turn engineering data book and catalog. Write today!

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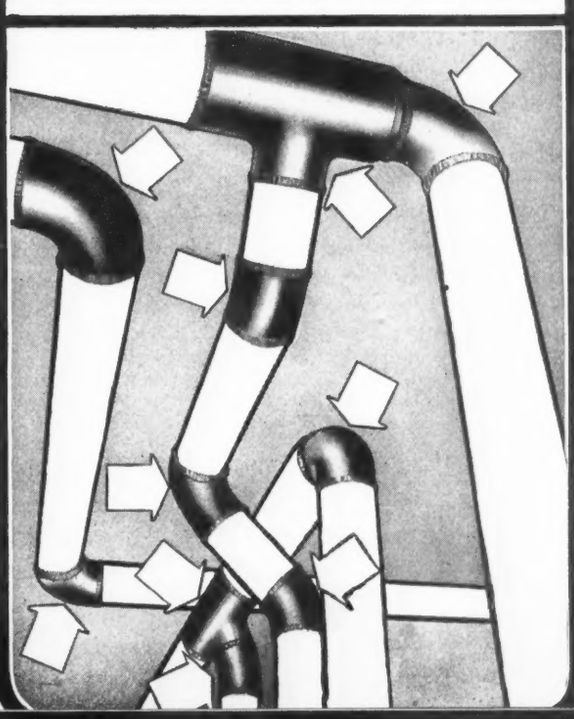
Welding ★The★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*

WELDING WITH TUBE-TURNS REMOVES "DANGER AT THE TURNS" IN PIPING

When you think of "turns" in piping systems, remember they occur within tees, reducers, laterals, nipples, heads, etc., as well as within elbows and returns. Wherever there are abrupt *changes in flow direction* you'll find *extra* wear and tear. TUBE-TURN welding fittings provide maximum *extra* strength and safety, and practically eliminate maintenance troubles, at these *danger spots.*



POWER LINES

PERSONALS

FRANK G VAUGHEN was honored October 2 at a dinner commemorating his completion of 50 years of service with the General Electric Co. Mr Vaughen started as a meter tester with the Thomson-Houston Electric Co, one of the parent companies of General Electric, and rose through the ranks to be known throughout the industry as the "Dean of Meter Men." A gold-plated watthour meter, number 21,555,778, was presented to Mr Vaughen on behalf of the Engineering and Mfg Divisions.

JOHN A O'BRIEN has been elected vice president of Johns-Manville Sales Corp. He will continue his duties as

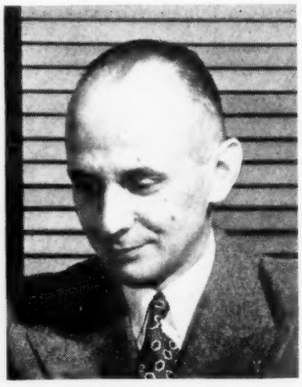
John O'Brien

general sales manager of power products and Industrial Dept, a post he has held since 1938. Mr O'Brien began his career with the company in 1915.

WALTER A PARRISH has been appointed executive engineer of the Superior Engine Div, National Supply Co, to have headquarters at the Springfield, Ohio, plant. Prior to his appointment he had been associated in various capacities with the Buda Engine Co, the Cummins Engine Co, Caterpillar Tractor Co, and others.

H S PAHREN was recently made manager of the Electric Power Sales Dept of Elliott Co. His headquarters will be at the Ridgway, Pa., works of the company. He had previously been district manager in the St. Louis office since 1936.

EDWIN A WERT has been appointed vice president in charge of engineering and sales of the Power Piping Div, Blaw-Knox Co. He has been a consultant for the company for a number of



Edwin Wert

years and comes from the Detroit Edison Co, where he had been engaged in an engineering and design capacity for 18 years. He is the inventor of the Blaw-Knox functional spring hangers and vibration eliminators for high-pressure and high-temperature piping.

CARL S HERRMAN has been elected chairman of the board and IRWIN L MOORE president of the New England Power Association. H I Harriman continues as vice chairman of the board. Mr Herrman, with the group since 1912, has been president since 1935.

HOWARD L CRUMLEY, 41, has been appointed operating vice president of the Virginia Public Service Co. He will have direct supervision over the company's operations and will have his headquarters at Alexandria, Va.

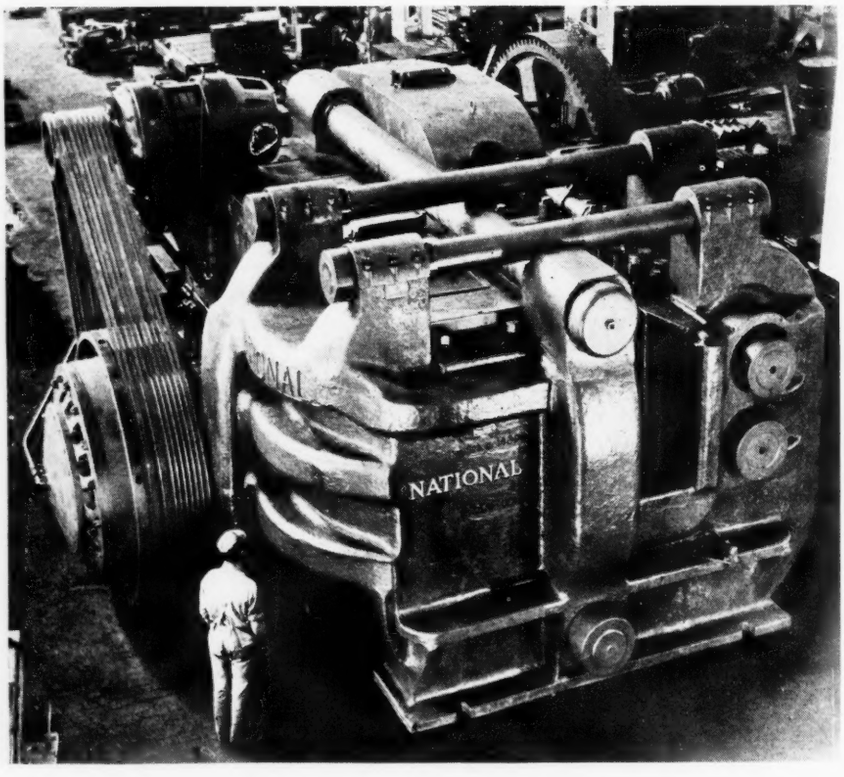
R M CUNDIFF has been appointed manager of the Cincinnati branch office of Bailey Meter Co. Mr Cundiff, a mechanical engineering graduate of the University of Kentucky, has been located in the company's New York office.

OBITUARIES

JOHN T SHELDRICK, 63, of Niagara Falls, N. Y., for many years stationary engineer of Devoes school there, died October 13 in Lockport, N. Y. He was

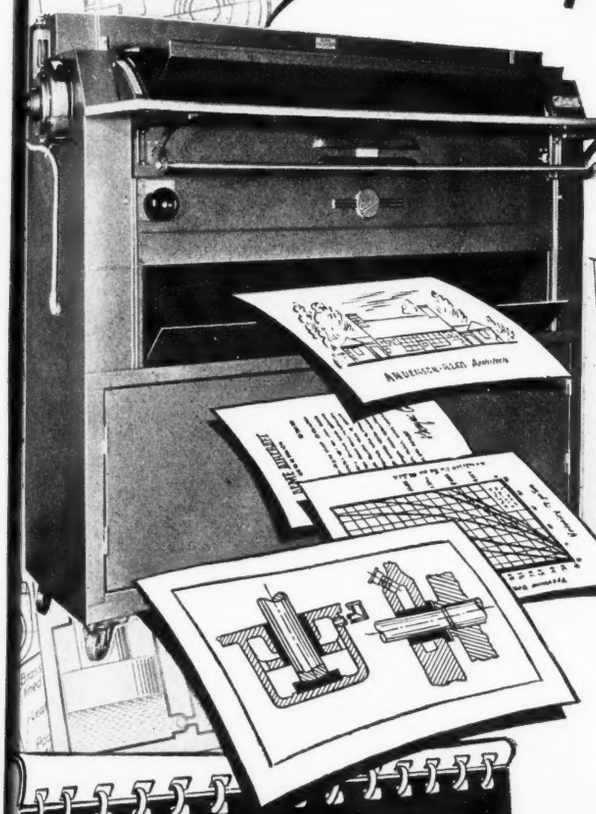
(*Continued on page* 160)

WORLD'S LARGEST FORGING MACHINES



Widespread attention is being focused on the current delivery of the world's largest forging machines to Tube-Turns, Inc, at Louisville, Kentucky. These two huge forges are rated at 9" capacity—a feat of designing and construction viewed as impossible a few years ago. Some idea of their size and potentialities may be gained from these figures. Each machine weighs over 500,000 lbs. and required well over a year to build. One of the most significant features is the extreme compactness, which can be visualized by considering that the weight of each machine is greater than the combined weight of 140 automobiles. If parked end to end, these cars would extend for more than half a mile—yet this unit occupies floor space sufficient to accommodate only four cars.

HERE'S ALL-PURPOSE PRINT MAKING IN ONE COMPACT UNIT



FOR A COMPLETE, all-purpose method of making prints—and today the demand is for a service more versatile than blue-printing—the Ozalid Process offers a full line of sensitized materials and Whiteprint machines that combine exposure and dry development in one compact unit.

By using the Ozalid Process, you get—in a matter of seconds—positive-type whiteprints of engineering drawings or anything written, typewritten or drawn on reasonably translucent paper . . . prints that are true-to-scale, durable, and will not wrinkle or curl.

With this all-purpose process you get . . . SUCH STANDARD MATERIALS as papers producing black, blue or maroon lines on a white background . . . transparent materials including transparent papers, cloth and foils . . . SUCH SPECIALTIES as paper laminated on cloth . . . airmail weight paper . . . paper coated on both sides . . . opaque cloth . . . correctors for eradicating line detail . . . SUCH SERVICE as fast—economical—print making.

Ozalid whiteprints are made simply by placing the original on a piece of Ozalid sensitized material and feeding both into the machine. Exposure and dry development are combined in the machine to produce a finished print that is dry, ready for immediate use. Ozalid transparent duplicates are produced the same simple way.

Compare this quick, complete process with the indirect way of making blue prints which requires washing—fixing—drying and trimming. Eliminate unnecessary production tie-ups by installing an Ozalid machine. Write for illustrated literature today.

SPECIFY Ozalid WHITEPRINTS

BASIC FACTS ABOUT PRINT MAKING YOU SHOULD KNOW

AN OZALID TRANSPARENT DUPLICATE CAN BE CHANGED AND CORRECTIONS ADDED TO THE SAME PRINT IN EITHER PENCIL OR INK. Subsequent prints will show all the changes . . . the original remaining intact!

Changes and additions are made quickly on a transparent duplicate either by using Ozalid Corrector Fluid for incidental or scattered changes, or the Ozalid "block-out" method for major corrections. Both eliminate the necessity of complete retracing and provide short cuts in drafting.

The corrected transparent duplicate produces prints at a speed 3 to 5 times faster than is possible with a Van Dyke negative. The prints are permanent . . . free of distortion . . . and the changes true-to-scale.

Ozalid transparent materials include a variety of papers, cloth and foils, any of which may be used as a duplicate original for making subsequent work prints. This enables you to file your valuable originals and keep them safe from wear and tear.

This is the second of a series of facts on modern print making. Watch for Fact No. 3.

OZALID PRODUCTS DIVISION
GENERAL ANILINE & FILM CORPORATION
JOHNSON CITY, N.Y.
Ozalid in Canada • HUGHES OWEN CO. LTD., Montreal

No Justice . . .

Old Si was hauling a wagonload of apples to market. As his team toiled up a long hill, the tailboard loosened, unbeknownst to Si, and the apples trickled out one by one. A neighbor saw what was happening, and remembering Si's reputation as the hardest cusser in those parts, dodged behind the fence row to the hilltop where Si would rest his team—and probably find out about that tailboard. The old man stopped his team, discovered his lost load, then just turned around and started back home. Not a swear word passed his lips.

"What's the matter, Si? Losing your grip?" called the neighbor.

"Hell," said Si, shaking his head, "I can't do this one justice!"

I think similar reasoning has been behind the shortage of printed information on water treatment. It's a tricky subject. Available books and articles are pretty deep, requiring almost a degree in chemistry to understand.

That's why I shook my head when the editors of POWER admitted they were planning a special section on this subject. With Si I said, "Hell, you can't do it justice!"

But they have. I've seen advance sheets of the 32 pages on feedwater in this issue, and I think they've got something. At least it's enough so that you and I can talk with one of the experts and not be hopelessly swamped. Undoubtedly the section isn't as complete as it might be, but it's a lot better than nothing—and can serve as a base for the building of an ever-increasing amount of information.

The editors will run into trouble over it—everybody who tries something new always does. People thought Columbus was crazy, and they jailed Galileo for telling the truth. But only the man who sticks out his neck contributes something to the world's advancement. And the world, like a bicycle, will fall down if it stands still. It's got to keep on going.

So—as the first guy to say it couldn't be done, I want to be the first to say it has. I also want to pass on to those potential critics, now seeing this section for the first time, the story of the critical family on its way home from church. The old man hadn't liked the sermon. His wife said the organist made a lot of mistakes. Sister fussed about the choir. But they all shut up when little Billy chipped in with, "I think it was a darn good show for a nickel!"

George Edwards

Engineer

For every industrial service there is a JOHNS-MANVILLE INSULATION specially designed to provide highest operating efficiency, long life and maximum fuel savings - - -

Here are brief facts on a few of the most widely used J-M Insulations. For full details, and for information on J-M Insulation Engineering Service, write Johns-Manville, 22 E. 40th St., New York, N.Y.

• • •

FOR STEAM LINES UP TO 600° F.—J-M 85% Magnesia Pipe Insulation. For many years this material has been proving its ability to maintain its high insulating efficiency in service. It is the most widely used power-plant insulation.

FOR STEAM LINES UP TO 700° F.—J-M Asbesto-Sponge Felted Pipe Insulation is recommended where maximum efficiency, salvage value and resistance to vibration and abuse are essential.

FOR HIGH-PRESSURE SUPERHEATED STEAM LINES—J-M Superex Combination Insulation, consisting of an inner layer of Superex high-temperature insulation and an outer layer of J-M 85% Magnesia or Asbesto-Sponge Felted. Combines unusual heat resistance and high insulating efficiency.

FOR BOILER DRUMS, WATER WALLS, FEED-WATER HEATERS, TANKS, BREECHINGS AND UP-TAKES—J-M 85% Magnesia Blocks for temperatures up to 600° F. Strong, durable, lastingly efficient.

FOR COLD-WATER LINES—J-M Anti-Sweat Pipe Insulation—a cold-water pipe insulation designed to prevent condensation and damage from dripping.

FOR REFRIGERATED SERVICE—J-M Rock Cork Sheets and Pipe Insulation—basically mineral, Rock Cork cannot rot and will not harbor vermin or support mold. It is highly moisture-resistant and retains its unusually high insulating efficiency indefinitely. Widely used for refrigerated equipment and piping, air-conditioning ducts and cold-storage rooms.

FOR FURNACE INSULATION—J-M Superex Blocks, for years the most widely used block insulation for temperatures up to 1900° F. Combines high heat resistance with low thermal conductivity.

J-M Insulating Brick (3 types) and J-M Insulating Fire Brick (4 types) for temperatures up to 2600° F. Furnished in all standard 9" shapes of the 2½" and 3" series, as well as in special shapes.

Also J-M Sil-O-Cel C-3 Concrete, cast on the job from Sil-O-Cel C-3 aggregate and cement. Sets up into a strong, durable semi-refractory insulating concrete for temperatures up to 1800° F.

BACK TO WORK
THESE USED DARTS GO

We would like to make a suggestion—in the interest of the conservation of metals for National Defense.

Maybe, somewhere around your plant, there are some scrap piles of old pipe on which there are also discarded unions. Our suggestion is that these pipes be examined and if any *Dart* Unions are found, have them removed and put back into active service.

Dart Unions have been designed and manufactured to be re-installed over and over and over—and give the same high satisfaction, the same "first-time" tightness, each time. Dart's matched bronze seats, ground to "true-ball" surfaces sees to *that*. And the fact that Dart bodies and nuts are made of air refined malleable iron explains why Dart Unions resist pipe strains, rust, abuse—and reach such a ripe old age.

Understand—we make the suggestion that you find and re-install your used Darts purely in behalf of metal conservation. If you need to invest in additional Darts, get in touch with your local supplier. Because of the way Dart Unions are made—and what they are made *of*, Darts *do* constitute an investment that pays big dividends, for a long time.

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Argument Corner

(*Continued from page* 109)

to form a belt around them and fixed at one point to each pulley. With this arrangement a quarter turn of the cranks opened the valves and a little movement of the cranks in the opposite direction closed them.

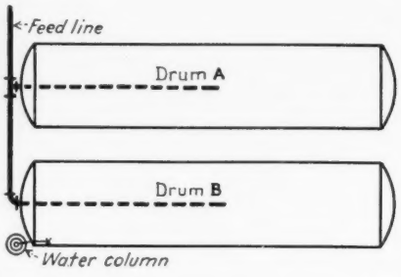
Houston, Texas CHARLES C LYNDE

Water Column Sampling?

DUDLEY K FRENCH discusses the question of taking boiler-water samples and stresses the point of making sure that the sample is representative, in the October number. The spotlight is thrown on the water column as if this were the only place or even the best place from which to take a water sample.

I admit that the water column is the most convenient place to take the water sample and being the most convenient it is the usual place, but in many boilers, if not in most boilers, it is a poor place to take a representative sample. This will become plain from the following experience in one plant.

The boilers are 2-drum, longitudinal, straight-tube, sectional-header units. The only connection between the two drums is that they have a common mud box. The water column is on one of the drums and the feed water enters both drums.



As is the usual practice, samples of water were being taken from the water column until one day out of curiosity, a sample was taken from the continuous-blowdown line. It was very surprising to discover that the sample from the continuous blowdown was several times more concentrated than the water-column sample.

We went about to find out why there was this discrepancy. We kept records of the test results from the three points, that is, the water column, and from the continuous-blowdown line from each drum. We found out that the water-column drum had ½ or ⅓ lower concentration than the other drum. Samples taken from the same drum, one from

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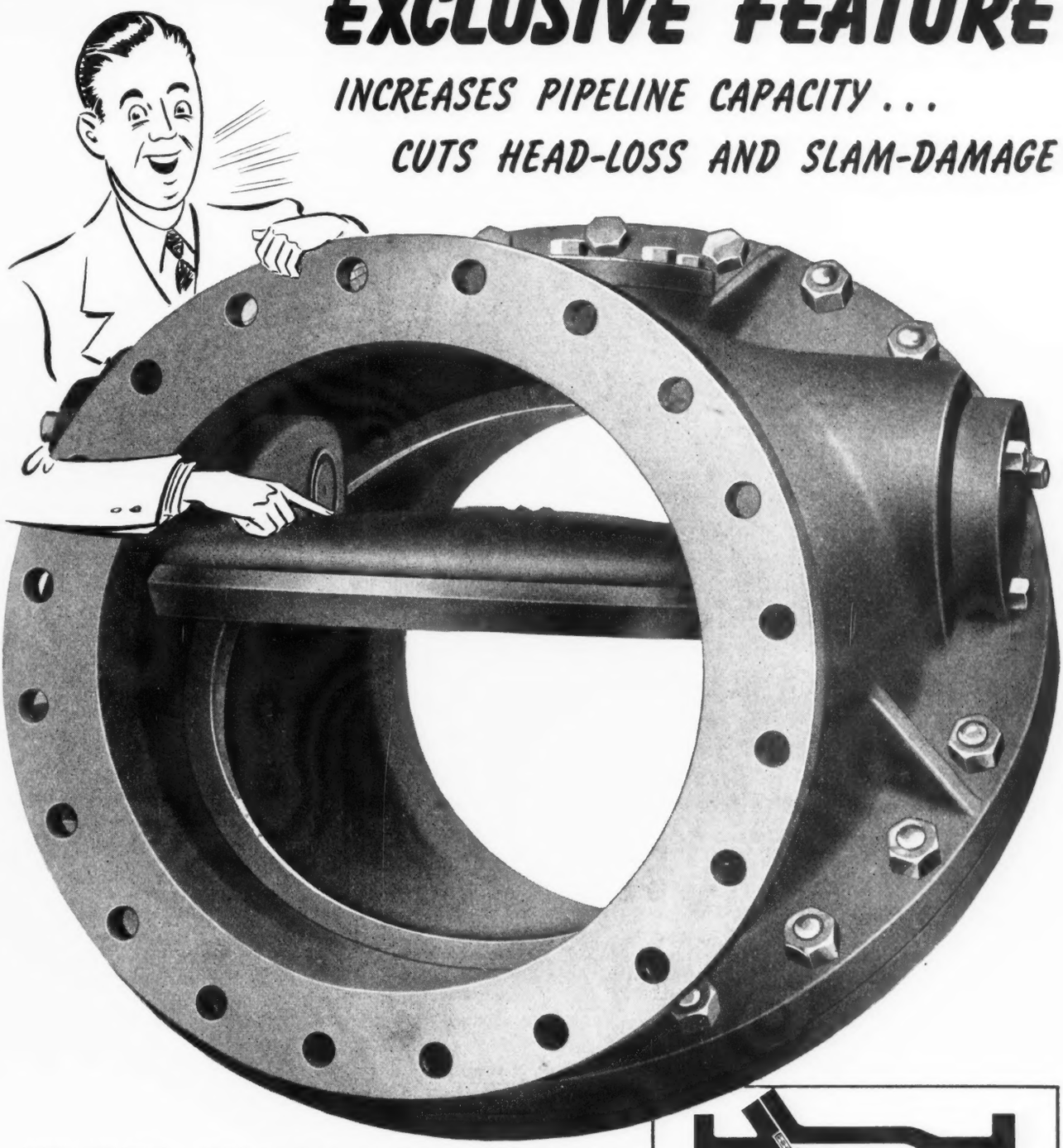

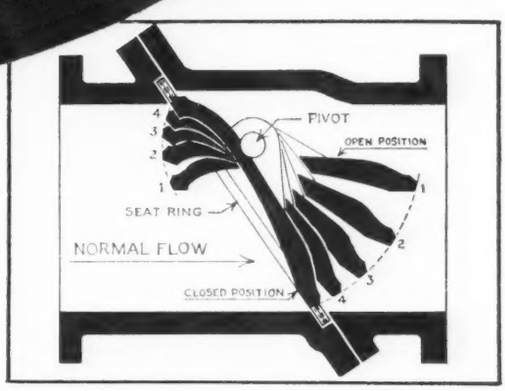

THE TILTING DISC in Chapman's Non-Slam Check Valve closes quietly to a drop-tight seat, without any rubbing or wear. And this *cushioned closing* cuts head-loss 65 to 80% . . . prevents slam, surging and opened pipe-joints. See exactly how these unique check valves are increasing operating efficiency and cutting pumping and maintenance costs for many prominent power plants. Send for free 12-page book that "tells all."

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CHAPMAN NON-SLAM, TILTING DISC CHECK VALVES

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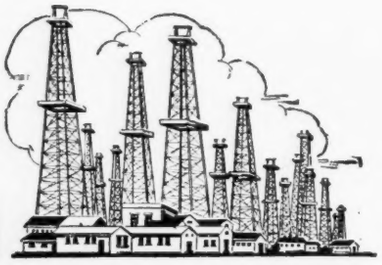
FOR OIL



NOW, when every production minute has an increased value, no plant can afford to have unnecessary delays and equipment failures caused by inadequate packings. That's why it is important to pack with Belmont—the packings that are pre-planned for service.

Below are two of the many Belmont Packings especially made for Oil Services, packings that will perform their tasks faithfully—even under the strain of 24-hour-day operations. Both Belmont 6100 and 189 are made from selected high grade asbestos yarn, braided, and treated with an exclusive lubricant for ultimate wear and greater efficiency.

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the water column and another from the continuous-blowdown line showed a variation of from 10 to 100 per cent the water column always being of lower concentration.

Since the feedwater concentration is much less than that of the boiler water, the thought came that the low-concentration drum was getting more feedwater than the high-concentration drum. It was later established that this is possible can be seen from diagram showing the location of the feed lines.

It is seen that the momentum of flow will carry more water to drum *B* than to *A*. To prove that it was so we put a valve on the line leading to drum *B*, and by partly closing this valve we could keep the concentration in the two drums at various ratios.

As to the difference between the water-column and continuous-blowdown line sample of the same drum, that is explained as follows: The water column has a steam and a water connection. After a water column is blown, the space is first filled with steam and after condensing this will dilute the water to a certain extent so that the sample taken from the water column is affected. Normally this dilution is very small but under certain conditions it can be so appreciable as to render the water-column sample worthless. For example, if the bottom connection to the water column is partly stopped, as is quite often the case, it will be some time before enough water can enter the water column to assume the true level. During this time steam from the top connection is condensing and if the lines are long a greater part of the water filling the water column may be pure condensate. That was true in the case of this plant. The reason why the difference of concentration was greater at one time than at another was caused by the partly stopped bottom connection.

It should be obvious from the above that the water column is not a good place to take a sample under normal conditions. Being a convenient place, if it is to be used, it should be checked from time to time with samples taken from other points.

Chicago, Ill. N T PEF

Test Shows Efficiency

(*Continued from page* 122)

each forced-draft unit, a volumeter compensates for varying fuel-bed resistance and delivers the correct amount of combustion air. A velocity vane actuates a valve regulating air pressure, from an

HOBART CUTS STEAM COSTS

with modern, prepared COAL

POWER AND STEAM requirements at the Hobart Manufacturing Company, Troy, Ohio, are typical of the average medium-sized plant. This Company makes equipment for the preparation of food, such as meat choppers, food mixers, and potato peelers; and the merchandising of food, such as computing scales, coffee mills and meat slicers. It uses a large quantity of process steam. Part of its electric power is purchased, part is generated at the plant. New boiler equipment, recently installed, places the Company in a position to expand its power facilities when conditions justify. And the fuel? Modern, prepared COAL from the great bituminous fields served by Chesapeake and Ohio Lines.

"We rely on coal," says Mr. Vernon Edwards, chief engineer of the Hobart power plant, *"for dependable, trouble-free operation, higher efficiency and lower steam costs."*

Let our engineers point out POWER ECONOMIES in YOUR PLANT

The aid of Chesapeake and Ohio Fuel Service Engineers is given without cost to industrial plants requesting it. These fuel experts are consultants. They will visit and survey your plant, confer with your engineers and make practical suggestions for lowering steam costs, raising boiler efficiencies, reducing maintenance costs. Take advantage of this service. It may show you the way to extensive savings! Simply write to GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2901 Terminal Tower, Cleveland, Ohio.

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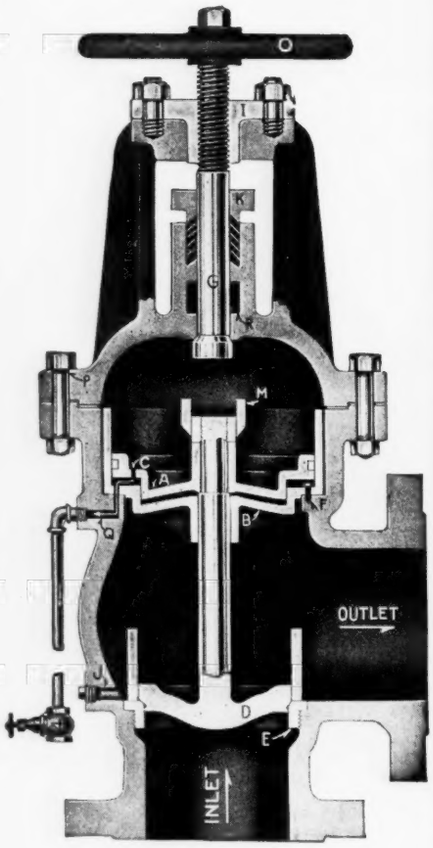
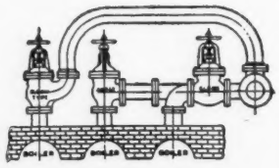
Golden Anderson SPECIALTY VALVES





NON-RETURN

• A tube bursting in one boiler means that the contents of every boiler in that battery are coming through that rupture *unless* there's a good non-return valve to stop it. To guard against such destruction, install an efficient, non-return valve that *will not* and *cannot* stick — such as the G-A non-return valve shown here. As far as we know, none of the many thousands in use has ever failed.

Safeguard the most valuable thing in the world—human life — with these G-A non-return valves.

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auxiliary fan, to a diaphragm which, in turn, makes a compensating adjustment in the forced-draft damper position, set by the master and the air-flow units.

The master also adjusts three controllers which regulate stoker speed. The furnace-draft regulator controls the boiler outlet dampers. This sequence insures that the damper is wide open before the stoker comes into operation. A constant-suction control measures breeching draft and adjusts the steam valve of the induced-draft turbine to maintain constant breeching draft. The turbine drives a single fan supplying all boilers.

Flyash settles in the hopper beneath the second and third passes of the boiler and is re-injected into the furnace through the bridge wall by air from the forced-draft duct. Flyash carried beyond the boiler is entrapped in a Prat-Daniel collecting system and disposed of with the ash from the grates. A Frederick Engineering Corp steam-jet system, consisting of a 20-ton hopper, flint-iron conveyor pipe, one ash inlet at each boiler and one connection to the flyash receiver, handles all ash.

Performance Guarantees

The performance guarantees incorporated in the specifications were as follows:

(a) The contractor shall guarantee a combined boiler, stoker and furnace efficiency of not less than 78% net, with any boiler under actual test while boiler is delivering steam equivalent to 300 hp and when burning coal as specified for stoker performance. He shall further guarantee a smoke emission of a density not to exceed No. 1 on the Ringelmann Chart during this test.

(b) Combustion equipment shall be so arranged and controlled that each boiler will supply steam demands varying uniformly from no load to 13,500 lb of steam per hr. within 20-min intervals while maintaining steam pressure within 2½ lb of the set control pressure and without manual adjustment or alteration of the automatic controls. With any one of any combination of boilers operating under such fluctuating load, the density of smoke emission shall not exceed No. 1 on the Ringelmann Chart for more than momentary intervals.

(c) Under no conditions of operation between ratings of zero and 200% shall the density of smoke emission be equal to or exceed No. 3 on the Ringelmann Chart for more than 5 min in any 60-min interval, or No. 2 Ringelmann for more than 10 min during any 60-min interval.

Only Anderson
SUPER-SILVERTOP STEAM TRAP *has*

STRAIGHT-IN-LINE CONNECTION
plus

ELBOW CONNECTION
plus
GUIDED INVERTED BUCKET
plus
NO CORED PASSAGES

NOT JUST ONE but *all four* trap features—that's what you get with Anderson Super-Silvertop and only with Super-Silvertop.

Straight-in-line piping saves fittings and installation labor because you need not buy and install extra, expensive fittings in any size of trap. Straight-in-line piping also presents a neater, streamlined appearance that is in keeping with other modern equipment.

Besides, all Super-Silvertop pipe connections are in the head of the trap and this gives a saving in head room as well as greater ease of inspection without disturbing pipe connections.

But Anderson Super-Silvertops have other features—optional elbow connections, guided inverted bucket and drilled, *not cored* passages within the trap. These features plus long, trouble free service life and a company backed by 54 years of steam trap manufacturing experience are the reasons for the constantly growing popularity of Anderson Super-Silvertop steam trap—the engineered steam trap that has everything. Do you want a copy of the book, "How To Choose a Steam Trap"? It's free.

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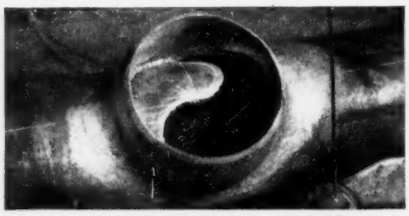
THREDOLETS
. . . Welded Outlets for Piping . . .

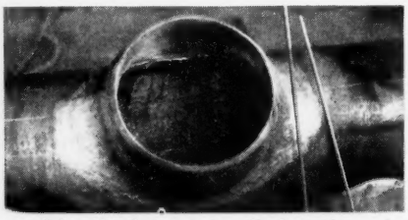
How to Make Leakproof Branch Pipe Connections in 6 Easy Steps

1 Select the position of the outlet. Rub the WeldOlet or ThredOlet over the pipe several times at about the position of the outlet to remove scale and dirt and then mark center lines. The fitting is then tacked into position.

2 Tacking is done in a sufficient number of places to insure its desired position. No clamps are necessary. Then weld, following and filling in the bevel along the base of the fitting. This assures a junction of full pipe strength.

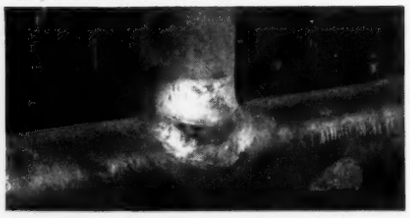


3 When the outlet of the WeldOlet or ThredOlet exceeds 2", weld the fitting to the main pipe and then remove the button—in two sections as illustrated. On fittings where the outlet is smaller than 2" or under unusual conditions on the larger sizes, the fitting should be used as a templet and the hole cut in the main pipe first.



4 After the fitting is installed on the main pipe and the button removed, the inside of the joint is in full view for inspection. Interior inspection is impossible with welded pipe-to-pipe intersections, welding tees, saddles, etc. Icicles, scale and excess welding metal are eliminated when WeldOlets or ThredOlets are used. They are removed with the button.

5 The branch pipe is then firmly tacked to the outlet of the WeldOlet which is beveled at an angle of 45°. To complete the junction, it is only necessary to bevel the end of the branch pipe at 45° and weld it into place. When using ThredOlets, the threaded pipe is screwed into position, or if Socket-End WeldOlets are used, the branch pipe is slipped into the fitting and an ordinary weld made around the top of the fitting.



6 The job is then complete. Note the trim, mechanical appearance. WeldOlets and ThredOlets form clean, unobstructed branch connections. Their funnel-shaped intake aperture reduces turbulence and friction. No templets are required, nor is it necessary to do complicated cutting and forming.

WeldOlets and ThredOlets are made of drop forged steel in size-to-size and reducing sizes for all standard pipe sizes. They are recommended for all commonly used pressures and temperatures on all types of piping installations. They can also be furnished in Monel, Everdur, Toncan Iron, etc. to meet special conditions. Write today for complete catalog telling the full story of all their advantages and the savings possible.

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The Finest that Money Can Buy
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After the plant was put in operation, official tests were made by the US Bureau of Mines Fuel Economy Service, the results of which are given in the tabulation on page 122. The boiler efficiency (item *A*, heat absorbed by boiler) proved to be 79.6%, exceeding the guarantee by 1.6%, and approaching the maximum for simple boiler design without extended-heating surface. With water walls, and economizers or preheaters, efficiencies well into the 80's might be obtained.

Fuels Conference

(*Continued from page* 128)

Jackson, Combustion Engrg Co; J S Bennett, 3rd, American Engrg Co; and F S Scott, Westinghouse Elec & Mfg Co; described the stokers made by their organizations and discussed methods of firing to obtain maximum efficiency on various coals.

Coal characteristics determine to some extent which type of stoker is best suited for each installation. High-ash, free-burning, and low-ash-fusion coals are more suitable to the traveling-grate stoker where the fuel bed is not agitated. These fuels include lignite, coke breeze, and small sizes of anthracite. Considerable trouble is encountered when burning different grades of coal in the same stoker if the coals are not thoroughly mixed. Uniform mixing of coals is difficult, and with a coking coal on one half of the grate, and a free-burning coal on the other, satisfactory combustion results cannot be expected.

On any stoker, as the air pressure impressed on the under side is increased, it tends more and more to lift the fuel bed off the grates. The faster the fuel is burning the smaller are the particles of coke and the less dense is this coke, which accelerates the blowing. This lifting tendency limits maximum burning rate. Ash content of coal for stoker firing can be classed both as a detriment and an advantage. It forms an insulation and protects the stoker parts from the heat, but it also forms clinkers which adhere to the side walls and stoker parts. The method of handling coal which is to be stoker fired is responsible for some unsatisfactory combustion performance. Improper design of delivery chutes and bins causes segregation. When this size-segregation occurs across the stoker hopper uneven fuel burning will result. Uneven burning can also result from

"Mike" Speed of Eagle-Globe-Royal Indemnity Co. and Herman Dost, Chief Electrician of Pennsylvania Sugar Co., on a periodic "sleuthing expedition" to detect faulty insulation . . . they keep Pennsylvania Sugar's big generators running.

Quick, Watson, The "MEGGER" Tester

"Every Saturday before and after our week-end cleaning, the 'Wizard' (that's what we call Herman Dost) applies our 'Megger' Tester to all of our important generating equipment. Usually nothing happens, except that some figures are added to our records of insulation resistance.

Then one day the 'Megger' test indicates that somewhere there's a leak. Maybe an innocent wire has rubbed against a jittery frame and, like the surgeon's X-ray, the 'Megger' test detects the condition and a failure is forestalled.

With our insulation resistance records, we further watch any progressive weakening of the 'arteries' and have warning that permits us to make repairs at convenient times, rather than tie up all or part of our plant. Newly wound motors and wiring installations also have to submit to the 'Megger' test and not infrequently a blow-up is thereby averted.

A maintenance gang without a 'Megger' Tester would be like a hospital without an X-ray machine."

DAN GUTLEBEN,
Chief Engineer at the Pennsylvania Sugar Company's Philadelphia Refinery.

"MEGGER"
Trade Mark
Reg. U. S. Pat. Off.

Any one with an equal determination to forestall trouble can match this splendid record and enjoy similar freedom from power failure and unnecessary repair bills. Write for Bulletin 1655-W on Getting Results with "Megger" Insulation Testers.

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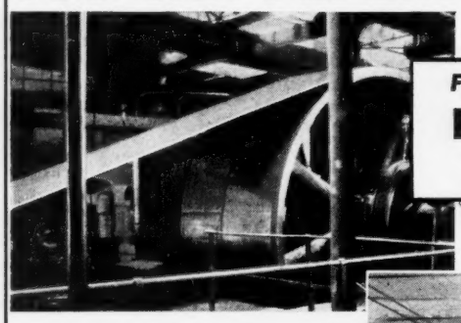
YOU CAN DEPEND ON TANNATE



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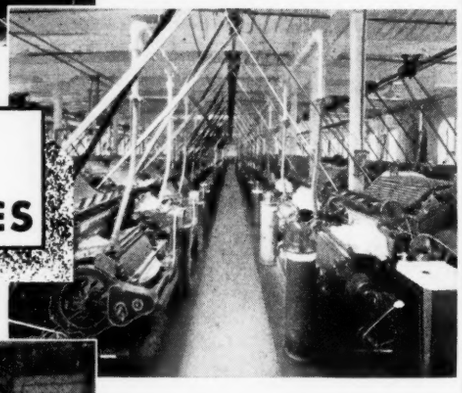

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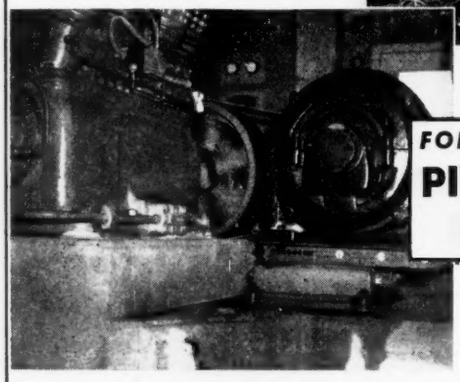

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In normal times and during every period of industrial emergency and growth, QUALITY LEATHER BELTING has positively proven its fitness to INCREASE PRODUCTION. You can rely on it today as you relied on it since the birth of American Industry. Use TANNATE (proven quality) Leather Belting for Primary Drives; Group Drives; or in connection with the well known Rockwood Pivoted-Motor Base (TANNATE-Rockwood Drives). For any purpose, it will lessen shutdowns and save time and money.

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STEP UP PRODUCTION WITH
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Established 1702
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having stoker pushers in the same plane adjusted with different lengths of stroke.

Combustion efficiency is dependent on many features peculiar to each plant. The manufacturer's representative should be called in at intervals as a check on whether or not the original operating instructions are being followed. In a great many cases these instructions are passed on by word of mouth and as the plant personnel changes from time to time, some important items are overlooked in passing the information to the next man.

Improvements in preparation developed by the anthracite industry are largely responsible for the high quality of the product and its resultant economic advantage in the anthracite market area, according to J H Kerrick of the Philadelphia & Reading Coal & Iron Co. Along with this improvement of quality there has been a careful and exhaustive study of proper boiler-furnace and arch design. These designs give more effective aid to ignition of the fuel and recovery of the heat released through the combustion process.

Other improvements have increased the speed of traveling-grate stokers from 15 to 40-100 ft per hr, and burning rates from 25 to over 50 lb per sq ft per hr.

Maple Hill Plant

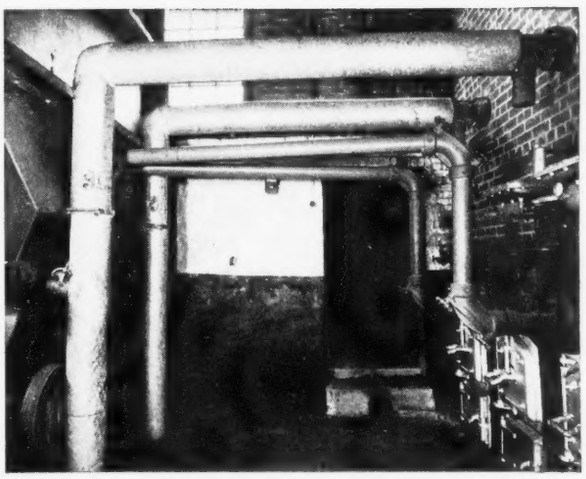
The Maple Hill steam plant of the Philadelphia & Reading Coal & Iron Co was described as a typical traveling-grate-stoker plant burning No. 4 buckwheat anthracite. Furnace design incorporates a rear arch extending over the grate toward the front of the furnace, to direct flow of lean gas to mix with rich gas from the front of the fuel bed. This permits operation with minimum excess air and improves combustion. Partitioning of the wind boxes under the stoker gives better control of fuel burning over the grate area, especially with grates of large size.

C H Frick, Pennsylvania Power & Light Co, presented operating experience using anthracite in pulverized form. Pulverized anthracite has one important advantage over bituminous in that the explosion hazard is not as great because of its low volatile content. One disadvantage is its higher grinding cost in power consumption and maintenance of equipment. Because the ignition temperature for anthracite is about 300 F higher than bituminous it is not possible to be as liberal in the use of waterwall cooling with the former as with the latter.

In drying anthracite the temperature

39% ANNUAL RETURN ON INVESTMENT

Earned by IRON FIREMAN Pneumatic Spreaders in Nicetown Dye Works



7 Important Benefits

Here is the record of two Iron Fireman Pneumatic Spreaders which replaced stokers of another type in the power plant of the Nicetown Dye Works Co. in Philadelphia.

1 **Fuel cost per 1000 pounds of steam dropped from 34 to 25 cents—a saving of 26.4%.**

2 **Coal consumption during nine-hour banking period was cut from 5,000 to 500 pounds—saving 4,500 pounds daily.**

3 **Cost of power for operating stokers declined 65%.**

4 **Boiler room labor was reduced substantially.**

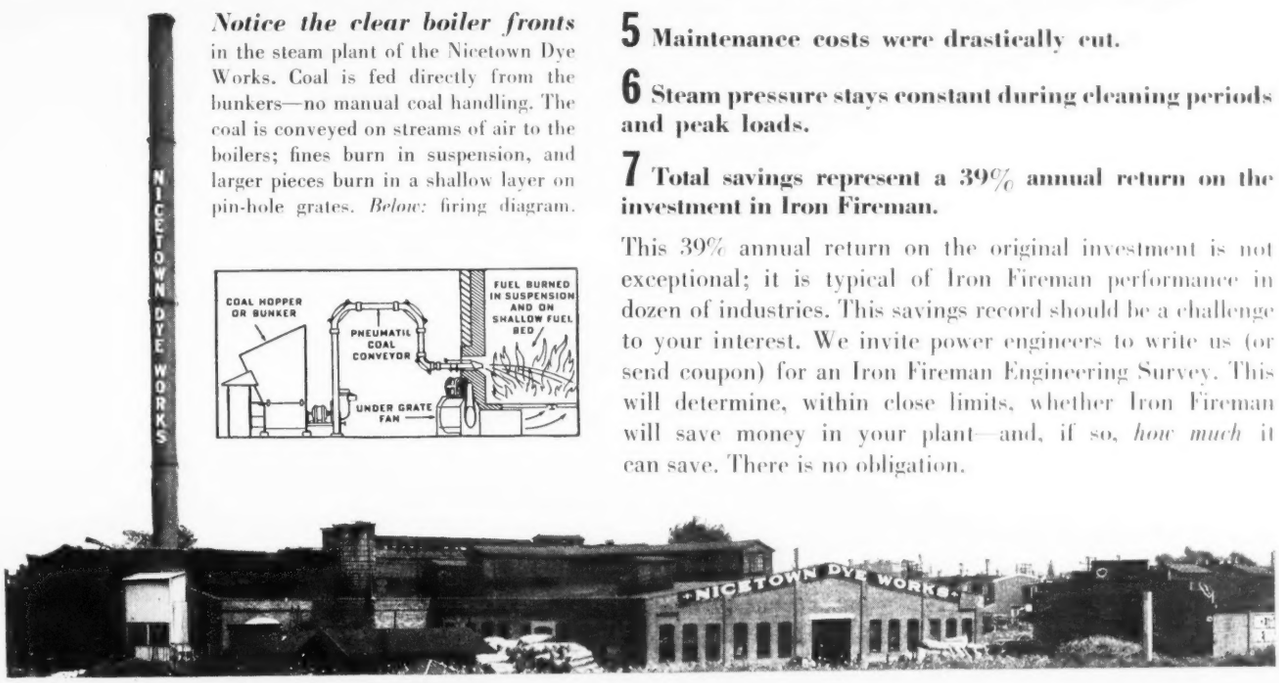
5 **Maintenance costs were drastically cut.**

6 **Steam pressure stays constant during cleaning periods and peak loads.**

7 **Total savings represent a 39% annual return on the investment in Iron Fireman.**

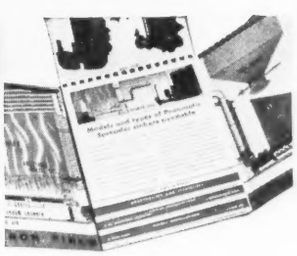
This 39% annual return on the original investment is not exceptional; it is typical of Iron Fireman performance in dozen of industries. This savings record should be a challenge to your interest. We invite power engineers to write us (or send coupon) for an Iron Fireman Engineering Survey. This will determine, within close limits, whether Iron Fireman will save money in your plant—and, if so, *how much* it can save. There is no obligation.

Notice the clear boiler fronts in the steam plant of the Nicetown Dye Works. Coal is fed directly from the bunkers—no manual coal handling. The coal is conveyed on streams of air to the boilers; fines burn in suspension, and larger pieces burn in a shallow layer on pin-hole grates. *Below:* firing diagram.



IRON FIREMAN

Automatic Coal Stokers



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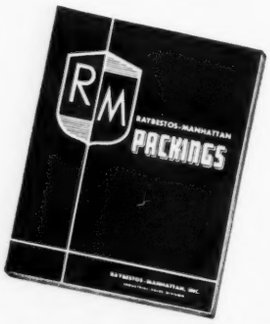
Wherever industry is racing against time for National Defense, R/M packings are taking punishment. They're standing the added strains, the constant pounding, the increased pressures of today's industrial speed-up. They're doing a swell job wherever water or steam, gas or oil, or corrosive chemicals must be controlled. They're getting it in the neck—and *liking* it!

40 years of specialization in asbestos and rubber have given Raybestos-Manhattan packings the needed stamina to see industry through its present emergency. Tough as a Top Sergeant, masterful as a General, R/M packings handle difficult situations with ease—require less attention—help boost production above capacity—and *keep* it there!



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can be higher than bituminous, because it will not lose its volatile matter as quickly; this gives considerable reduction in drying time. This advantage is important because, with the small sizes of anthracite used, moisture content is usually high (from 8 to 15%). This results from the large amount of water used in preparation and presents a serious handling problem in winter when delivered coal may be frozen in railroad cars.

Mr Frick described two additional boilers which will be installed in the Hauto station. These will be the largest boilers ever designed to burn pulverized anthracite. The storage system of pulverizing will be used as it has advantages which are valuable to a public-utility station.

Reader's Problems

(*Continued from page* 103)

Air Conditioning Is the Answer

As GHA's CEILING IS 10 FT high, the installation of a hood over the space occupied by the steam presses is a simple matter. This can be constructed out of 10-gage metal with a 24-in. exhaust orifice in the centre leading to the exterior. A 24-in. exhaust fan completes the installation, which if properly operated can be guaranteed to lower the temperature of the factory 10 to 15 F. Proper operation means that the windows must be adjusted to control the air volume to be changed.

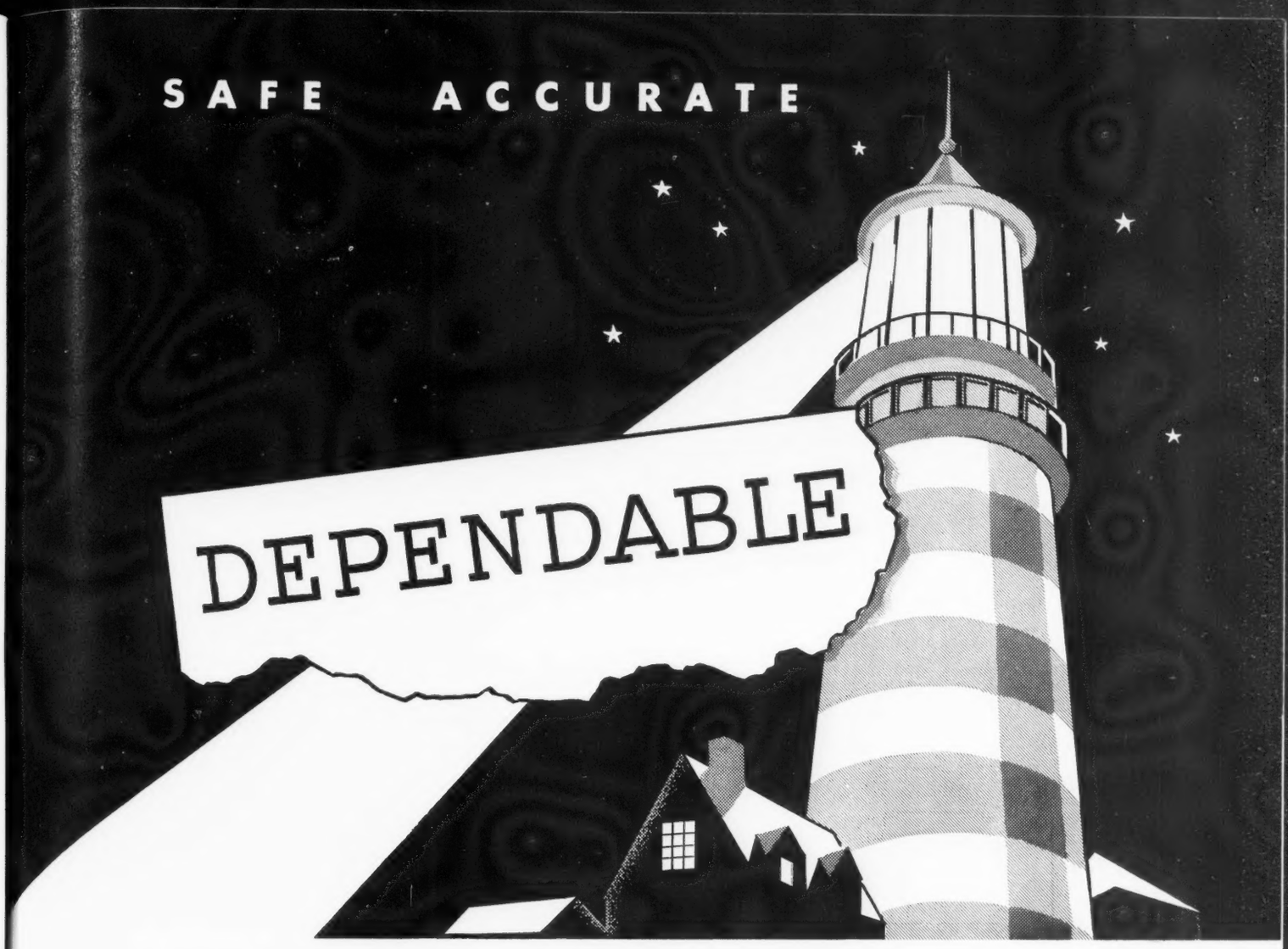
A more expensive and perhaps more efficient method would be to air condition the plant by retaining the first mentioned hood but eliminating the exhaust fan. All windows should be kept closed, and freshly washed and cooled air brought in through ducts and registers located in the four walls near the floor. An intake of 60,000 cu ft per hour will easily control the temperature, purity and humidity, and at the same time will not create an uncomfortable or noticeable draft.

To GHA's question as to his two proposed exhaust fans, I should say definitely no. This type of installation will only aggravate the condition as it will distribute the steam heat of the presses over the entire room.

Los Angeles, Calif. ERICH SCHENK

Remove Heat at its Source

GHA CAN IMPROVE THE WORKING CONDITION of his sewing room by installing the two exhaust fans he proposes, if they are of sufficient capacity, to provide about a 1½-minute air change, and provision is made for controlling air circulation in the room.



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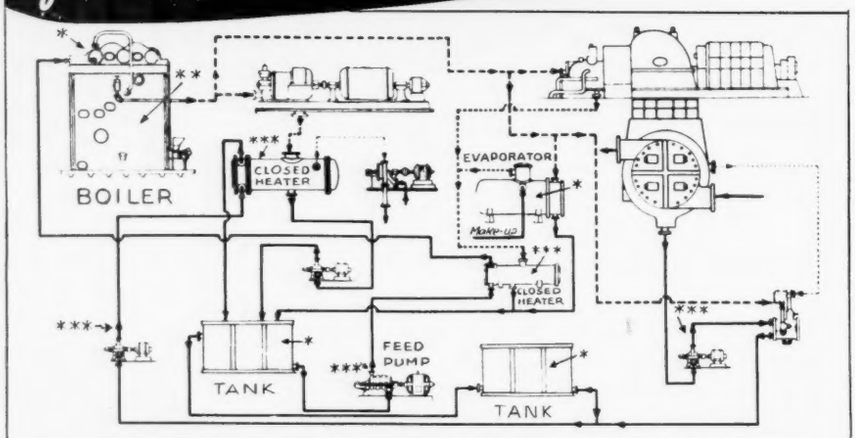

BALDWIN-HILL

Heat Insulation Products

The present emergency has forced many of us to wring all possible power output from our present equipment. B-H Insulations will help that equipment do double duty in the saving of operating dollars and the increase of generating capacity by reducing waste all along the line.

There is a type of B-H Insulation to meet every condition of service ranging from low to high temperature requirements. For any insulation problem or specific application, call in a B-H insulation engineer.

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Above you see a power hook-up for heating feed water with exhaust steam from house turbine which supplies power for motor-driven auxiliaries. We have marked a few places where B-H insulations are applicable.

* **B-H Rockwell BLANKET**
Effective to 1200° F. Fabricated of chemically stable B-H black rockwool in 12 styles utilizing various types of metal fabrics. Standard sizes: 2' x 4'; 2' x 8'; 1" to 8" thick.

** **B-H MONO-BLOCK**
Effective over the full temperature range up to 1600° F. Felted and bonded together, rockwool fibres are uniformly distributed to give maximum efficiency. Standard sizes: 18" to 36" long; 6" to 18" wide; 1" to 4" thick.

*** **B-H No. 1 Insulating CEMENT**
Effective up to 1800° F. and 100% reclaimable up to 1200° F. A plastic material with exceptionally high coverage and low volume shrinkage. Packed in 50 lb. bags.

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B-H No. 1 INSULATING CEMENT . . B-H WEATHERSEAL
and other heat insulations effective up to 2000° F.

A better method than the one proposed consists of installing a hood over the steam presses and connecting it to an exhaust fan having ample capacity to carry away the heat. An air change of one to 1½ minutes should be effective in preventing the circulation of heat from the presses. The method shown in GHA's original sketch makes no provision for preventing this heat circulation throughout the room.

If one fan is used for exhausting air from a hood over the presses, and another is used to exhaust the remainder of the room air from a gathering duct run near the ceiling, along the center of the room, considerable reduction in temperature will result.

Humidity can be controlled successfully only through the use of air-conditioning equipment employing apparatus which will cool the air below its dewpoint.

Louisville, Ky. I A Butcher

How to Ventilate

GHA's problem proves difficult because the exhaust fans are located too near the windows. I would recommend the fans to be placed 20 ft from opposite ends and mounted on opposite walls of the room. This will change the air and also permit inflow of air to be properly diffused rather than pass directly from inlet to outlet.

If fresh air is needed, it is better to admit it at a low level and discharge at the ceiling, as the natural ascent of the air will be rapid due to its temperature. A number of small inlets rather than one or two large ones will distribute the air better, which will make it more comfortable for the operators.

Goderich, Ont., Canada George Barrett

Install Hood at Steam Press

In GHA's problem it is apparent that most of his trouble is caused by the vapor and heat given off by the steam presses.

As one solution I suggest that a hood be erected over the steam press area, connected by a duct to an exhaust fan, the exhaust from this fan to be carried out a window or through the roof.

By this means the vapor and heat from the presses would be removed, thereby reducing the humidity and leaving the room more comfortable.

New York, N. Y. Anthony Greer

Answers to Question 2

(*Continued from page* 103)

of pipe to either side of the run of a tee placed with the side outlet on the top of the suction pipe.

Connect a float-control tank to the suction tee directly above the suction pipe, using a relatively small connecting pipe, possibly 1 or 1½ in. in diameter. This

IN the past 38 years, Pittsburgh Piping & Equipment Company has fabricated and erected many piping systems that established records for higher operating pressures and temperatures. Special techniques developed in the Pittsburgh Piping shops have made possible more economical fabrication and safer, more efficient steam layout. Today more horse power is needed—and needed quickly—for expanding defense efforts. Pittsburgh Piping's wide experience guarantees extremely accurate fabrication and erection. And what is just as important, KNOWING HOW means SAVING TIME from start to finish.

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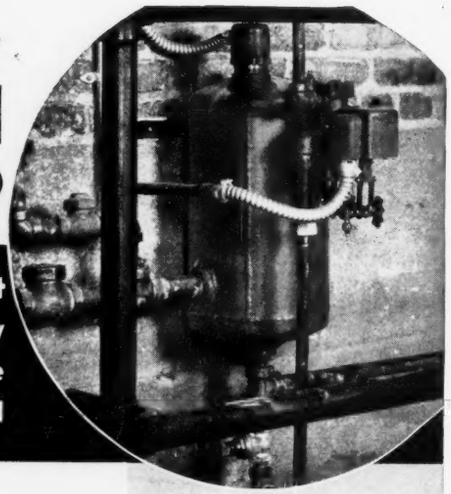
Know the JOHNSON ELECTRAP

The pumping trap that offers greater reliability . . . better performance . . . new remote control



USERS of Johnson Electrap call it the pumping trap that has everything.

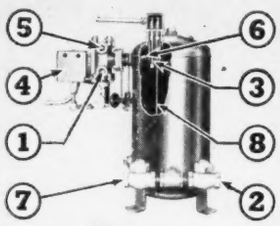
It is first of all absolutely dependable. The old mechanical system of floats and levers has given way to a modern electrical system of control. Stationary electrodes use the water in the trap to control an electric circuit to a solenoid valve, eliminating all floats, stuffing boxes, all moving parts, from the trap chamber. Operation is as dependable as the flow of electricity.

With this modern system of electrical operation the Electrap has reached new heights of performance. In many plants it has solved pumping problems that would ordinarily require steam or electric pumps, or cumbersome tilting traps. It is also being used to drain unusually *high* vacuum lines; Johnson Electraps, in many instances, are operating successfully under 27" of vacuum.

But perhaps the most welcome feature of the Electrap is its new remote control. Here at last is an answer for those piping layouts where a trap must be installed in some inaccessible spot. All the controlling valve gear — all the parts subject to any wear—are gathered into one compact assembly that can be mounted separate from the trap chamber, in any convenient location.

Write for new catalog. It lists sizes, shows piping layouts, to fit the Electrap into any plant.

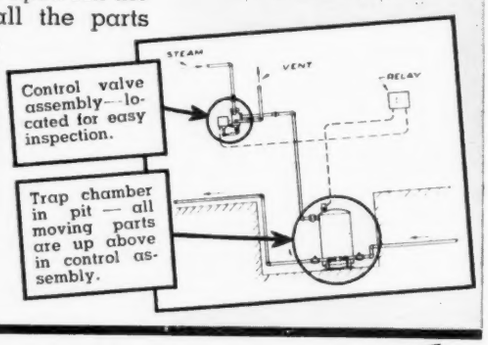
● Photo of Johnson Electrap installed in mill of the Eddy Paper Co., at White Pigeon, Mich. This unit is used to lift returns from heating equipment.



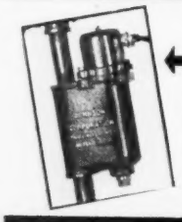
How the Electrap Works

When control valve is in normal position vent (1) is open and liquid to be lifted (or condensate) enters inlet (2). When water level in chamber reaches short electrode (3) electric circuit is completed through a relay. Relay actuates solenoid (4) which closes vent and opens inlet (5) to admit lifting or equalizing pressure to trap chamber through pipe (6). Contents of chamber are discharged through outlet (7) until water level falls below long electrode (8). Then control valve returns to normal and chamber can fill again.

MOUNT THE CONTROL VALVE ANYWHERE


Control valve assembly—located for easy inspection.
Trap chamber in pit — all moving parts are up above in control assembly.
STEAM
VENT
RELAY

OTHER JOHNSON DEVELOPMENTS



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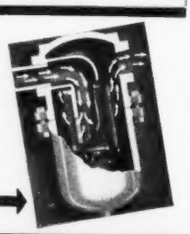

Products of The Johnson Corporation

865 WOOD STREET, THREE RIVERS, MICHIGAN

tank should be approximately 10 in. in diameter and about 36 in. high, and should be located with the bottom even with the centerline of the pumps. Two float switches are required in this tank. The lower float switch should be arranged to close a relay in the pump-motor circuit when the water level in the tank has risen to a point above the top of the pump volute, and to open this circuit if the level falls several inches below this cut-in point. A second float switch should be arranged to start a priming pump at a level 6 to 8 in. above the pump casing and stop the priming pump when the level is 12 to 15 in. above the main pump casing.

The priming pump may be any type of wet-vacuum pump capable of producing the required vacuum, and for ease of control should be motor driven. To insure satisfactory priming of the main pumps, the vents on top of the casings should be connected to the air space in the priming tank through suitable float valves which will pass any accumulation of air. The pump stuffing boxes must be provided with lantern glands and sealing water from a supply independent of the pump discharge.

This system would function automatically as follows: When the power is first turned on, the priming pump alone is started. When the water level in the priming tank is raised to the required point to prime the main pumps, one or the other is automatically started. The priming pump continues to operate until the level in the float-control tank is high enough to keep the main pumps in operation, and then functions intermittently to remove air as it accumulates in the priming tank. Should the draw-down of the well be such that the priming pump cannot maintain the required level in the tank, the main pumps will be shut down until such time as sufficient water accumulates.

Harrison, N. J. E F WRIGHT

Use a Bypass System

SINCE ETG STATES THAT IT IS IMPRACTICAL to solve the problem with any scheme which involves digging up the floor, the possibility of reducing the friction loss in the suction piping by using larger pipe or an independent suction line is eliminated. When ETG states that the suction lift is about 18 to 21 ft, we assume that this figure includes any static lift plus all the friction losses in the suction piping. The reduction of the actual lift would obviously solve this problem, but the only means of such a solution is enlarging the present suction piping. This solution would reduce the suction head and flashing in the impeller eye would be avoided. The capacity falls off as the suction lift becomes greater and when the lift becomes so great that flashing takes place in the impeller eye, the pump will vapor-bind and lose its suction. The problem then resolves itself into one of altering or adjusting the existing installation in order that the pumping units can be protected.

From the statement of the problem, it

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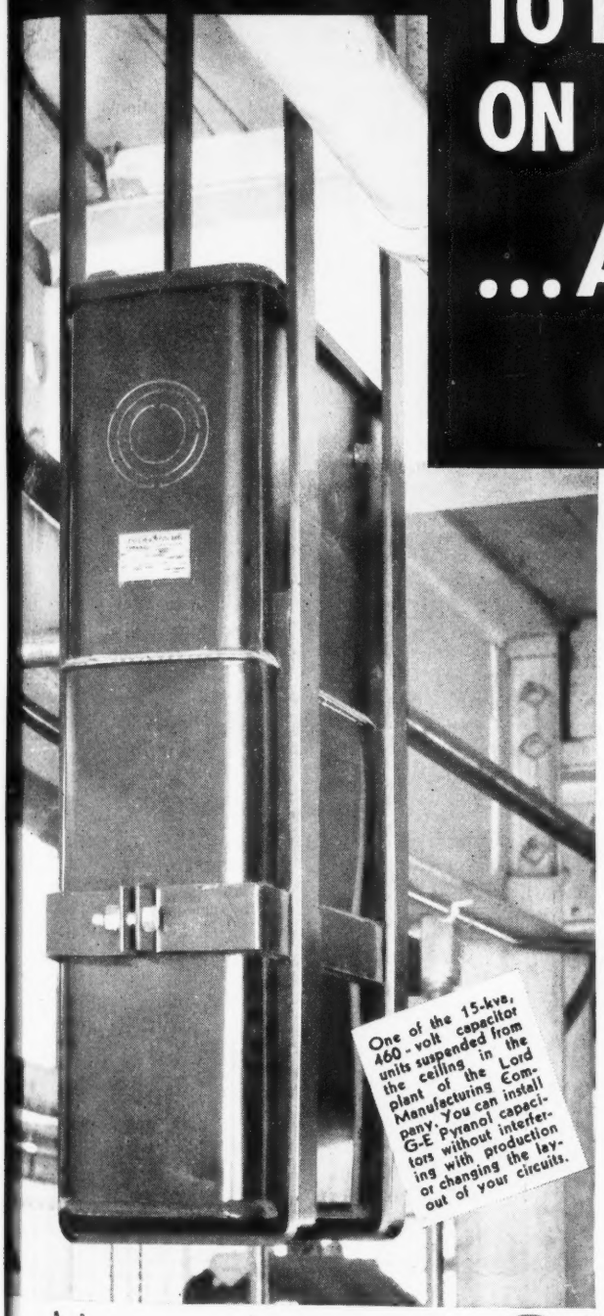
TO PROVIDE FOR MORE LOAD ON YOUR POWER CIRCUITS ...AT LOWEST COST, TOO!



One of the 15-kva, 460-volt capacitor units suspended from the ceiling in the plant of the Lord Manufacturing Company. You can install G-E Pyranol capacitors without interfering with production or changing the layout of your circuits.

DO YOU want to add more induction motors in your plant without installing additional generating equipment, transformers, switchgear, or feeders? Then investigate G-E Pyranol* capacitors. By neutralizing reactive kva, capacitors enable your circuits to carry more working current for additional motors and other equipment. The capacitors can be installed without interfering with production and they cost much less than other methods of providing additional capacity.

How Capacitors Released Capacity for One Industrial Plant

When the Lord Manufacturing Company, Erie, Pa., needed more power for production, a study showed that capacitors would release the additional capacity required. Capacitors totaling 80 kva were installed in various feeders in the plant, and power-factor was raised from 55 to 80 per cent. Here are the results:

1. The losses were reduced and voltage was improved — the line current was lowered from 168 to 129 amperes.

2. The generator output was increased from 75 to 85 kw.

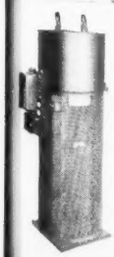
Extra Savings

In addition to releasing capacity in your plant, capacitors will reduce your power cost if your power contract contains a power-factor or kva demand clause. These savings may pay for the capacitors in one to three years, and then the savings will continue—so it's a highly profitable investment.

Get Complete Information

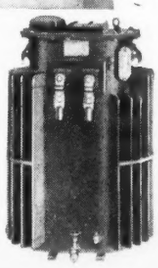
Investigate *your* opportunities to save with G-E Pyranol capacitors. Ask for our catalog, "Pyranol Capacitors for Industrial Applications," (GEA-77L). General Electric Co., Schenectady, N. Y.

**Reg. U.S. Pat. Off.*



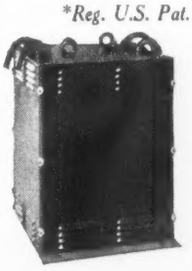
AIR-COOLED INDUCTION REGULATORS

Over-loaded circuits mean low voltage and inefficient operation of motors and lamps. G-E air-cooled induction voltage regulators will bring performance back to standard. And indoor installations are easy to make—no vault is required. (Bulletin GES-2285)



PYRANOL TRANSFORMERS

An easy way to provide for new loads. Install them indoors at *load centers* to get power right where you want it. No vaults required. Close-to-the-load installations save secondary copper, give better voltage, and reduce losses. (Bulletin GEA-2048B)



AIR-COOLED TRANSFORMERS

Like Pyranol transformers, these units can be installed indoors to obtain greater capacity plus savings in both time and materials. Particularly adapted to circuits 600 volts and below. (Bulletin GEA-897H)

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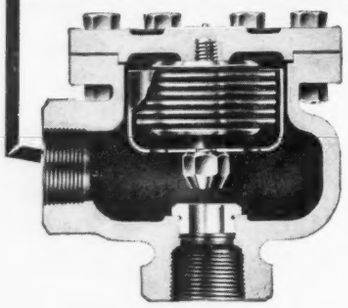

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These units employ temperature difference between steam and condensate to open and close their valves, a heavy duty thermostatic bellows with brazed end plates being the operating mechanism. They are sturdily constructed and designed for high pressure and severe service. Water and air discharging capacity are extremely high and positive intermittent valve action can be absolutely depended on.

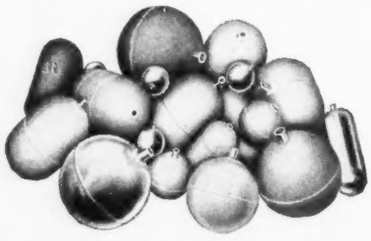
Other advantages include non-freezing, no air binding, dribbling or water-logging.

Available in types and sizes for all services from vacuum up to 300 lbs. with superheat. Ask for bulletin No. 439, or catalog No. 941 covering all types we make.

WELDED FLOATS FOR HIGH PRESSURE STEAM AND HYDRAULIC SERVICE

Available in spherical and elliptical shapes in sizes from 2½" to 14" diameter—in stainless steel and in chromium plated steel. Made for all steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.

"Nicholson" Welded Floats are *die formed* — not spun or laminated — with welding seam serving as reinforcing ring, and give extraordinary resistance to external pressure. Available also with cadmium, nickel or copper plating. Write for Bulletin No. 339 covering details.



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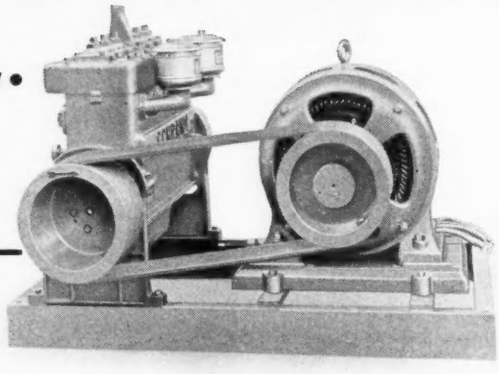

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SCHRAMM *Air Compressors*

is assumed that the pump is able to pump water at all times regardless of the suction lift if means is provided to prevent the water flashing. A bypass line running from the reservoir into the suction lines of either pipe is a possible solution. This bypass can be designed to circulate approximately 25 or 30 gpm, and to remain open at all times in order that flashing cannot take place at the impeller eye. When the pumps close down, the bypass line will serve to close the check valve and fill the suction line, so that the pumps are ready for operation without priming.

It will be necessary with such a bypass to accurately determine just what capacity is required at the suction eye of the impeller to prevent the water from flashing at this point. If the pump is normally designed for approximately 100 gpm, then approximately 25 to 30 gpm should be sufficient to accomplish this purpose. If ETG feels that the cost in power consumption of recirculating this quantity of water is too expensive, another means of bypass control presents itself. An automatic arrangement of the bypass can be controlled either by a flowmeter attached to the suction line of each pump, or by a pressure control attached to the discharge. In either case, the bypass would be automatically opened as the capacity decreased to a predetermined minimum. The bypass would remain open until sufficient water was pumped into the reservoir, at which time the float control in the reservoir would cut out the pump. The bypass would still remain open in order that the suction line be properly filled, when starting up again.

East Orange, N. J. R C McDonald

Reduce Discharge

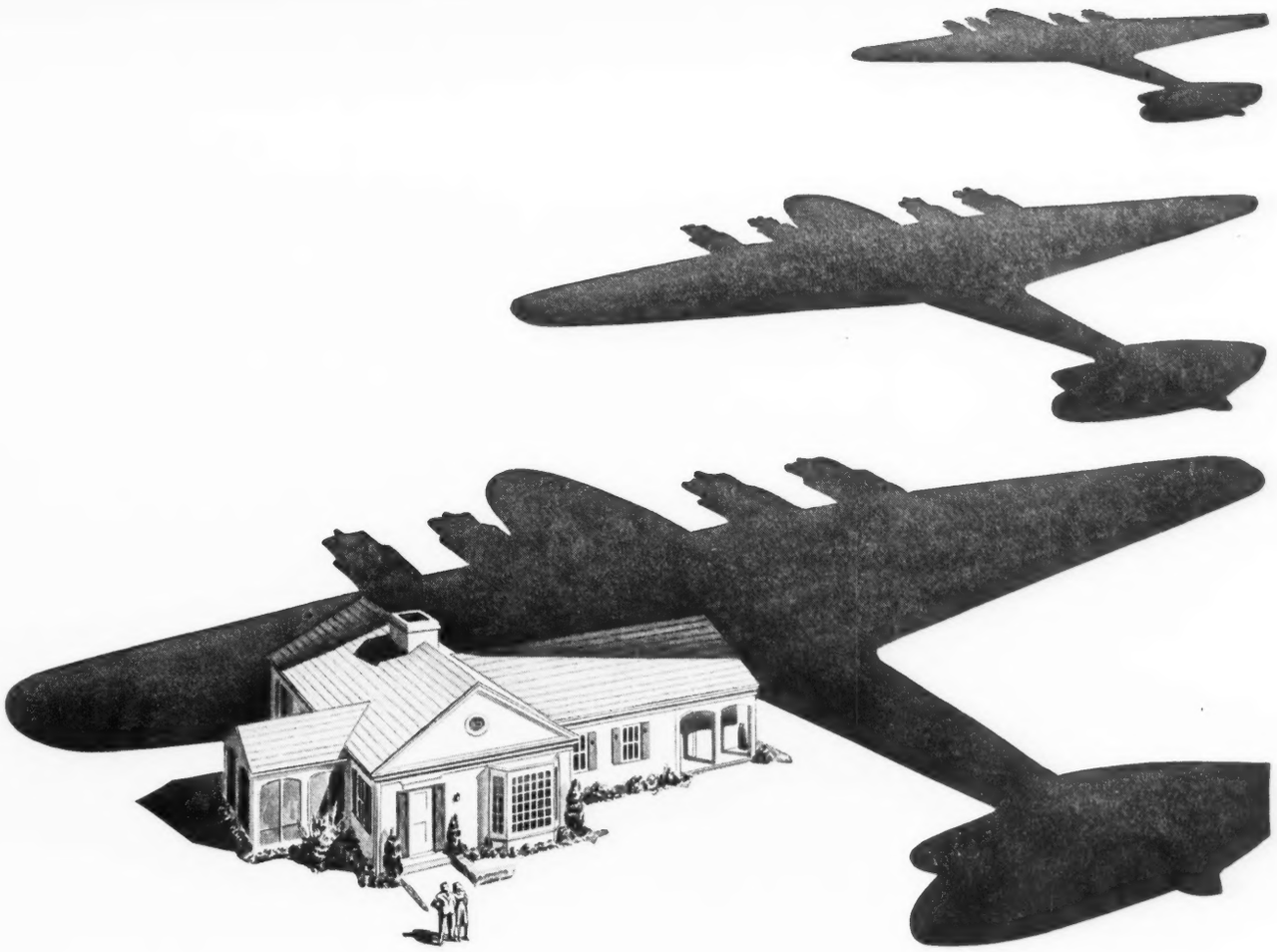
Since ETG's problem of suction loss occurs only during the dry season, it is obvious that the primary cause of his present difficulty is low water. The true solution would be to lower the pumps to give a maximum lift of 15 to 18 ft and to increase the suction-pipe size to give a velocity of 180 to 230 fpm.

Two other possible remedies suggest themselves, based on the theory that reducing the volume of water pumped will maintain the well water at high average level: (1) Set the float switch to operate within closer limits, (2) Install a bypass of small size around the discharge valve and operate with the discharge valve closed, the bypass to be open during the dry season. This will reduce the amount pumped, which will permit higher suction lift. Long-radius ells would be of some help in increasing the pump's lifting capacity.

Delaware, Ohio Frank Irwin

Install Series Pump

To ETG's suction trouble, I should like to suggest a check of the physical condition of the interior of the centrifugal pump. A slight slippage through the seal ring, which is easily caused by grit, will impair the performance of the pump. As



WHEN THE SHADOWS ARE GONE . . .

As spring follows winter, so peace will return, allowing the world to resume its progress to better ways of doing things. Far-sighted men are thinking of the future, keeping tomorrow in mind while doing today's urgent task.

Today we of Keasbey & Mattison willingly give precedence to orders from defense industries, as you would have us do. Our plants are running day and night, we are enlarging our working force and adding to our machine capacity. Even so we are finding it difficult at the present time to deliver some products to many of our customers.

But, like you, we are keeping one eye on the future. When normal times return . . . when we are able to ship you everything you want, when you want it . . . we expect to have found ways of doing things better, offering you asbestos products that will last longer, prove more economical and serve your purposes better.

To that end, we need your help now. Can you, who use asbestos materials, give us some ideas for tomorrow? Have you encountered some specific problem that could be overcome by a new application of asbestos? We will give thorough consideration to any suggestion, in the hope that it will prove to be practical from a manufacturing standpoint. We'd greatly appreciate a letter from you.

* * *

Nature made asbestos;
Keasbey & Mattison has made it serve mankind . . . since 1873.

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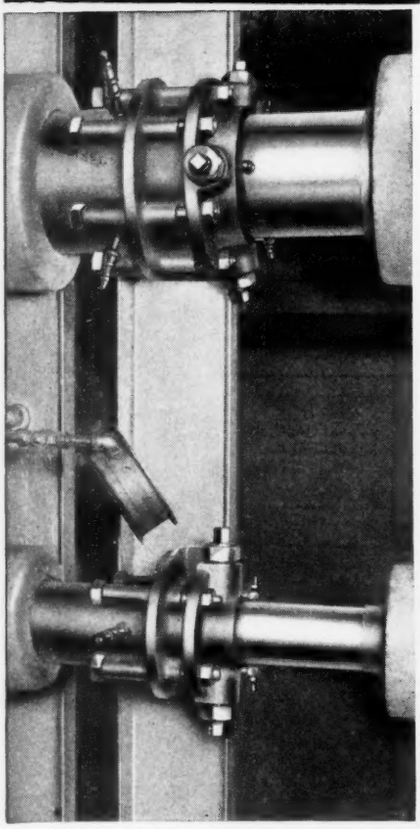

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Why don't you select the Expansion Joint that is packed under full steam pressure. A twist of a wrench forces a special semi-plastic packing into the stuffing box by means of integral pressure guns. No need to remove old packing. New packing rejuvenates the old. No need to shut off steam. Write for Catalog EJ-1907.

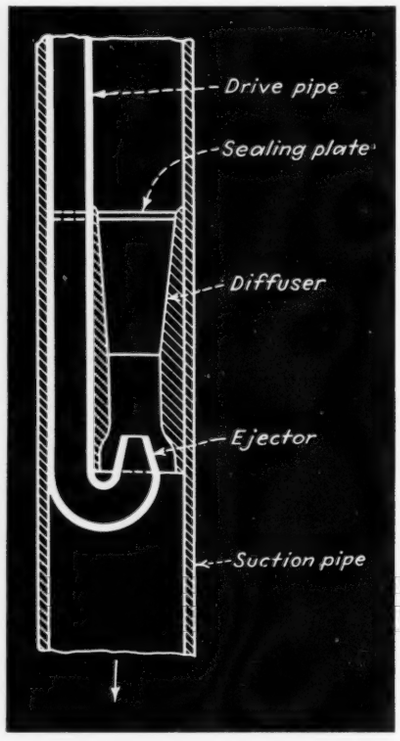
YARNALL-WARING CO.
100 Mermaid Ave., Phila., Pa.

it is not practical to enlarge the suction pipe, perhaps ETG would consider installing reciprocating pumps, or he can install an additional centrifugal pump in series with the present pumps. In both instances the present starting and stopping equipment can be used. Also the installation of a magnetic valve for priming the centrifugal pump, connected in parallel with the float-switch solenoid circuit, would be desirable.

Schenectady, N. Y. CARL BACHMANN

Install Ejector

AN ANALYSIS OF ETG'S PROBLEM indicates that all of the difficulties experienced in this installation are traceable to an excessive suction lift. In this particular case, the excessive lift is aggravated by the fact that the high suction-inlet velocities result in the formation of eddies at the pump suction and in the entrainment of large quantities of air. Natural well water is generally well saturated with



dissolved gases which, under the vacuum conditions prevailing because of the high lift, are dissociated at the pump entrance and help in the creation of air and gas pockets in the suction passageways. Taking all these facts into consideration, it is obvious that the pumps will lose suction at such times when the level in the well goes to its minimum.

Depending upon various factors, which can only be established from a more complete knowledge of the installation itself, there are several possible arrangements which would obviate the existing difficulties. These arrangements fall into two separate categories: (1) decrease of the unfavorable effects of high-suction-lift operation, (2) elimination of a condition whereby the pumps handle the water under a suction lift.

Inasmuch as a 3-in. pipe is already in-

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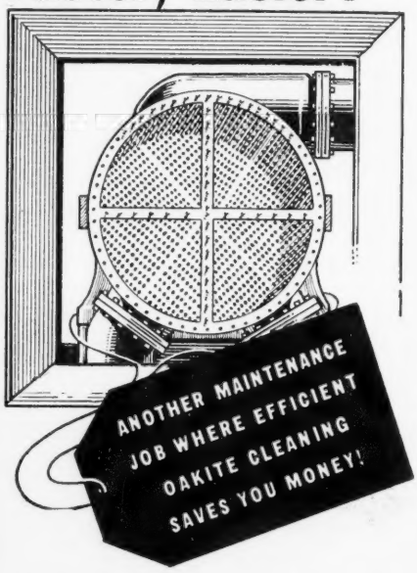

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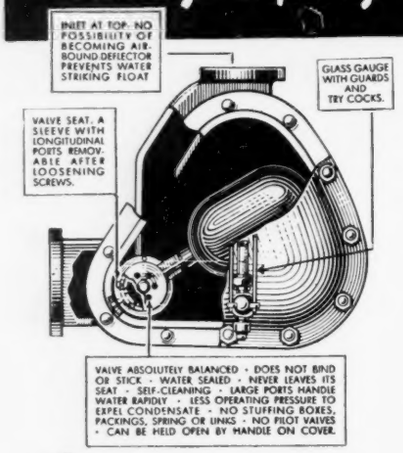
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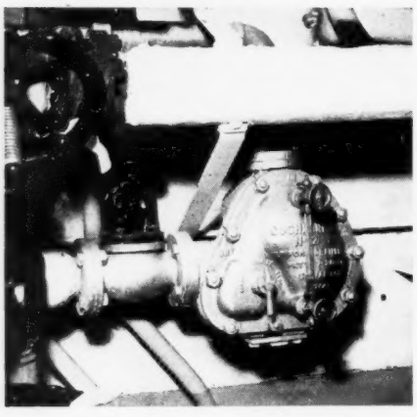

THE "Multiport" principle on which the Cochrane Drainer operates is that of a hollow cylindrical valve with a number of longitudinal ports which register with similar ports in the valve seat when the float is in the raised position. The combined capacities of these ports is unusually large, which accounts for the valve's extraordinary discharge capacity. For complete details mail this coupon.

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stalled, there is no reason why the friction losses and the suction velocity could not be appreciably reduced by utilizing this pipe instead of the 2½-in. pipe. This might possibly be accomplished by lowering the foot valve to the bottom of the 3-in. bore pipe and sealing it at that point. In addition, it might be worthwhile to check the installation for air leakage into the suction line from the idle pump. As the pumps have a common suction, there is nothing to prevent leakage of air through the stuffing boxes of the idle pump into the common suction pipe. If this leakage of air is excessive, it might account in itself for the loss of suction described. In order to eliminate this leakage, it is necessary to provide the stuffing boxes of both pumps with lanter-seal glands and supply these with water under pressure. This water could be diverted from the common discharge header, preferably from a point upstream of the discharge gate and check valves.

The second solution contemplates the use of a hydraulic ejector. There are a number of these ejectors on the market which might be used to improve this installation. The ejector is installed at the lowest level to which the water supply may fall and is connected to the pump by means of two pipes. One of these is the suction pipe proper, while the second is a pipe leading from the pump-discharge line to the drive side of the ejector. The foot valve is to be retained at the bottom of the 3-in. suction pipe. When the system is once primed, part of the discharge capacity is diverted down the drive pipe into the ejector. At this point, the pressure energy is converted into velocity energy, creating a suction effect at the throat of the ejector diffuser. This lifts the water through the foot valve into the ejector. Upon leaving the ejector throat, the velocity energy is reconverted into pressure energy, lifting the water into the pump suction. Such an arrangement can be used even when the static lift exceeds the theoretical maximum of 34 ft. which can be handled with a centrifugal pump. It may be, of course, that the size of a commercial ejector suitable for handling the required capacity of 100 gpm would exceed the diameter limitation imposed by the existing conditions. However, while the efficiency of a home-made injector may suffer in comparison with that of commercial models, it is entirely possible to design such a unit which would fit within the 2½-in. pipe.

The appended sketch shows schematically a suggested arrangement where the drive pipe, the accompanying ejector, and a sealing plate are all nestled inside the suction pipe. Since the pump would no longer handle the water under a suction lift, all the troubles which now occur would be eliminated.

South Orange, N. J. I. J. KARASSIK

Leaks Cause Vacuum Loss

ETG STATES, "Trouble has been encountered through the pump losing suction in periods of dry weather." From this it appears that during dry weather tailwater level at the suction line is mate-

AT LARGE

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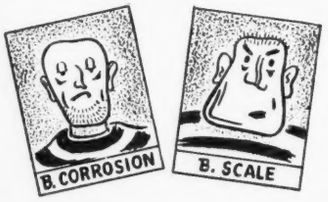
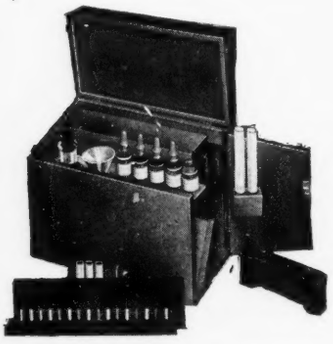


Boiler corrosion and scale can cost you time and money. But they can be corraled by controlling the pH and Phosphate in boiler water.



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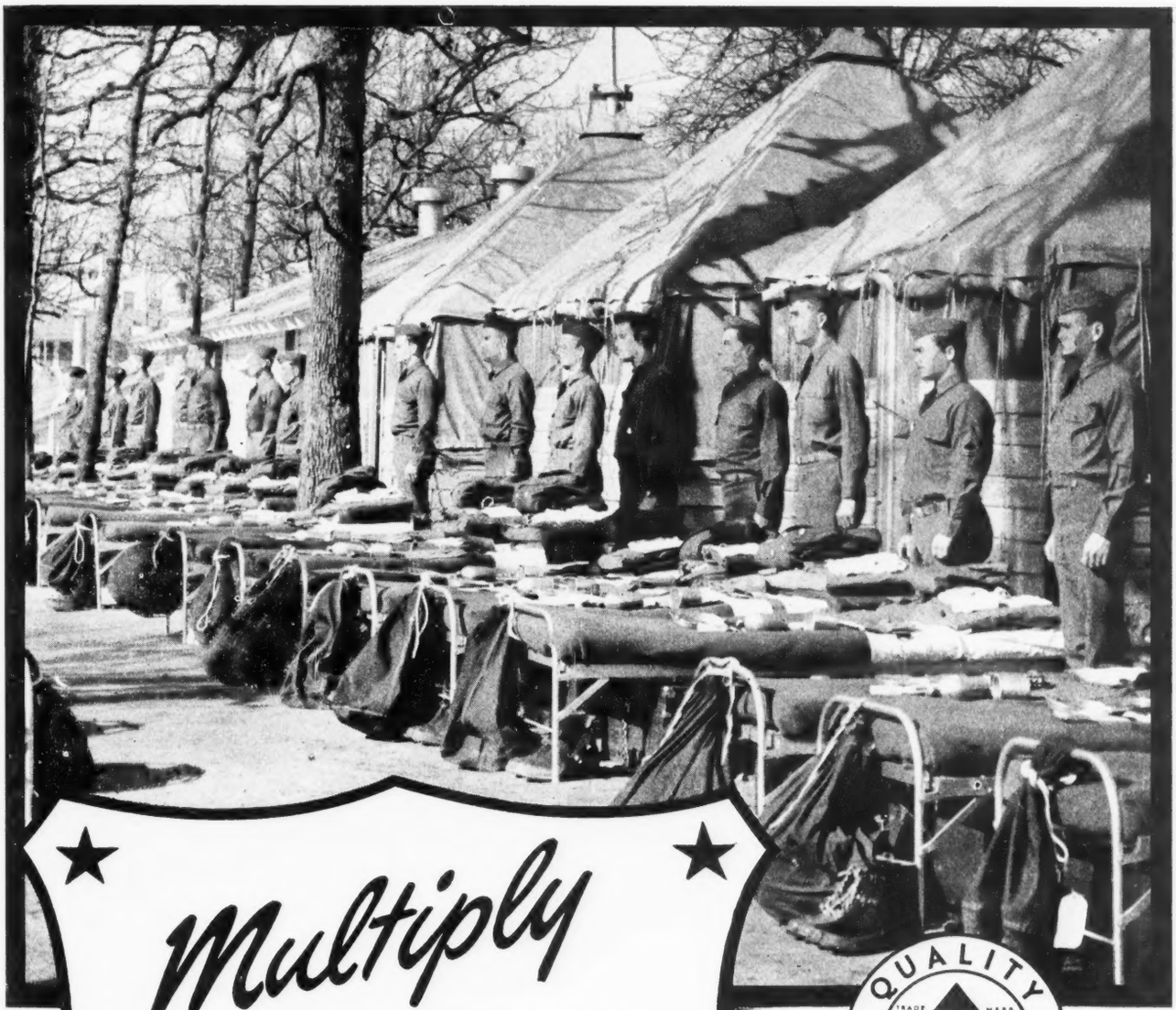

Multiply by 127,272

To make the eleven army cots you see here requires 128 feet of steel tubing, 195 feet of angle steel, 1073 feet of spring wire and 1933 feet of galvanized wire - not to mention rivets and other small pieces of steel.

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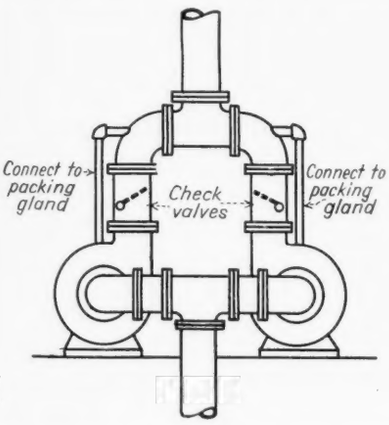
rially lower than normal, imposing a higher suction lift on the pump. The resulting higher vacuum in the suction line undoubtedly draws air through the stuffing box of the standby unit, lowering the vacuum or breaking it, so that the pump can no longer function under the required suction lift.

To remedy this, the stuffing box on both units should be water sealed by piping up as shown on the accompanying schematic drawing. If pump design is such that it has more than one stuffing box, then all stuffing boxes should be water sealed.

We also note that ETG found it necessary to reduce the suction pipe from 3 to $2\frac{1}{2}$ in., and assume that this applies only to the common suction pipe. However, if



the reduction in diameter has been made between the common suction line and the pump inlet, a check should be made so that the type of reducing fittings used are such that air pockets will not form. For correct application of reducing fittings on suction lines to centrifugal pumps, we refer ETG to Section B, page 25 of "Standards of Hydraulic Institute".

Holyoke, Mass. P J EQUI

Air Control

ETG'S PROBLEM IS CAUSED BY the water level in the well falling below the pump suction intake. If compressed air is available, an air line in the well, a pneumatic-pressure controller and a gradual-action pneumatic valve should do the trick. The valve should be installed in the pump-discharge pipe and is connected to the pressure control and air line as shown in the diagram.

The air supply should be at 15 lb per sq in. The needle valve should be adjusted to supply a trickle of air to the air line in the well. Since the submerged end of the air line is open, the pressure in this line is determined by the level of the water in the well.

When the water level approaches the point where there is danger of the pump losing suction, the reduced air pressure to the pressure control causes it to admit air to the pneumatic valve; partly closing it, thereby reducing the pump discharge by increasing the head.

The pressure control should operate on 0.1 lb per sq in. differential; that is, it should vary the pressure to the valve from

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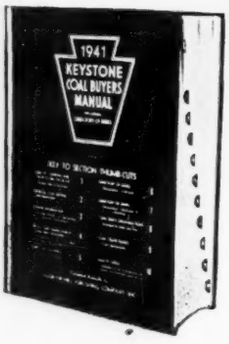

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P. 12-41

zero to 15 lb, as its control line pressure varies 0.1 lb. This is equal to approximately 3 in. variation in water level.

If a continuous flow of water is not necessary, a pressure switch could be used instead of the penumatic-pressure control and valve. The pressure switch should be wired to the magnetic starter to stop the pump when the water level falls, and to restart it when the water in the well rises to a safe level again.

Louisville, Ky. F A SCHMIDT

Vacuum Shutdown

ETG STATES THAT HIS PUMPS LOSE THEIR SUCTION in dry weather. If this is his trouble he can overcome it by installing on the suction line a vacuum-operated mercury switch so adjusted that when the suction head increases to the point where the pumps cease operation the switch will break the current and cut off the pump.

The recovery capacity of the well will determine what interval of time should elapse after the pumps have shut down before they can be started again and this will probably vary with the dryness of the weather.

However the simplest method would appear to be to throttle the discharge of the pump to the capacity of the well, if the reduction in flow is not too great. A valve in the discharge line would do the throttling trick and it could be set by hand on periodical visits of the attendant or it could be controlled electrically by a service motor and a suction-head switch.

Louisville, Ky. I A BUTCHER

Power Lines

(*Continued from page* 130)

a native of the town of Thomas, Ohio.

MICHAEL DIEMER, 88, veteran Rochester (N. Y.) power engineer, died recently. He came to this country from France, and had resided in Rochester since. He was an engineer of the Rochester State School for the Deaf for 52 years prior to his retirement.

L L BICHE, 53, manager of power transformer sales for the General Electric Co, died suddenly October 24. Graduated from Union College as an electrical engineer in June, 1912, he entered the employ of the company. Following a short test course, he was transferred to Transformer Div at Pittsfield, Mass. After service with the United States Army in the first World War, he returned to Pittsfield in 1919. In 1926 he was named manager of power transformer sales, the position he held at the time of his death.

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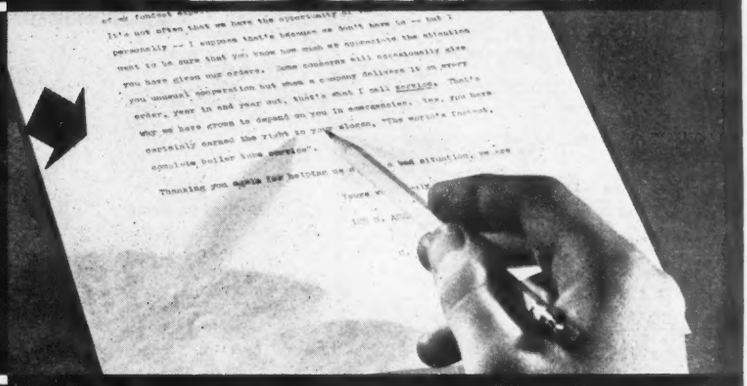

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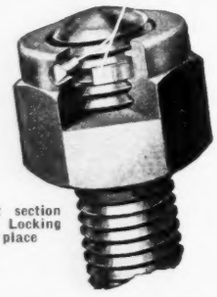

Cut out section showing Locking Ring in place

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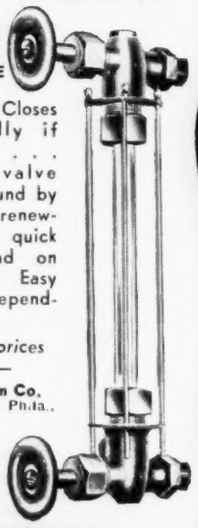

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WESTINGHOUSE ELECTRIC & MFG CO, East Pittsburgh, Pa., has announced appointment of Herbert A Cohn and Walter W Wendelken as superintendents in the building construction and maintenance Dept. Mr Cohn becomes steam superintendent responsible for all boiler plant and heating installations in connection with building projects. Mr Wendelken as electrical superintendent will supervise electrical design and specifications.

MANNING, MAXWELL & MOORE, INC, Bridgeport, Conn., announces appointment of Earl C Maund to the Chicago office in a sales and engineering capacity. He was formerly with the Cities Service Co and Sinclair Refining Co.

RIC-WIL CO, Cleveland, Ohio, announces two appointments. Fred Belser has been made general manager of the company, while A V DeFosset is now publicity director. Mr Belser has been with the company for several years in executive positions; Mr DeFossett comes from a previous position as assistant advertising manager of the Seiberling Rubber Co, Akron, Ohio.

CHAIN BELT CO, Milwaukee, Wis., announces appointment of A W Thomas as sales manager of Construction Machinery Div, D A Kalton as assistant sales manager and A J Frank as assistant to the manager of the Div. All have been connected with the company for many years and have had extensive experience in the construction machinery field.

Advertising Dept of YORK ICE MACHINERY CORP has left its former quarters in New York City and is now combined with Sales Promotion Dept of the company at headquarters in York, Pa. Anker Winther, assistant general sales manager of the corporation, will supervise the activities of the new Advertising and Sales Promotion Department.

LINK-BELT CO announces appointment of William A Craig as purchasing agent of the company's Philadelphia

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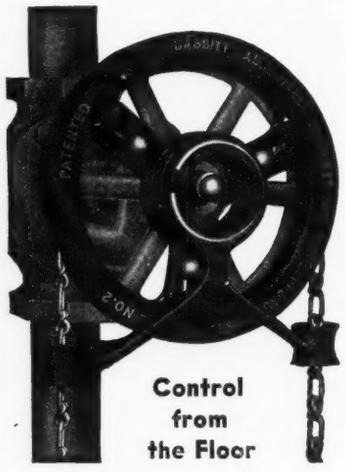

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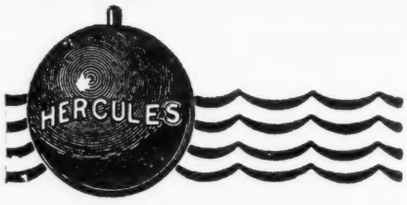

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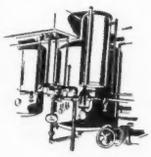
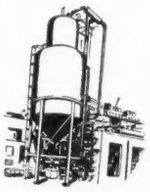
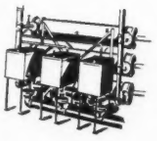
Permutit's field staff offers boilerfeed treatment of every type



ZEO-KARB H—Removes both hardness and bicarbonates from raw water. The effluent is soft and reduced in total solids and alkalinity. The sulfate-carbonate ratio may be adjusted by mixing effluents.

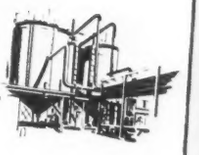


DEAERATING HEATER—Utilizing exhaust or bled steam. Guaranteed to remove all oxygen and free CO_2. It is designed for pressures up to 150 pounds or higher, capacities up to 1,400,000 pounds per hour.

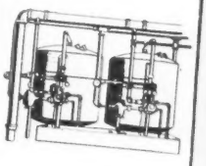


CONTINUOUS BLOWOFF—Maintains a uniform concentration of salts in the boiler salines and recovers the heat from the blowoff by means of a heat exchanger.

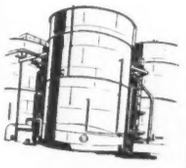
HOT LIME SODA—Lime and soda ash in correct proportions, precipitate the bulk of the hardness as calcium carbonate and magnesium hydroxide. The sludge is settled out, after which the water is filtered.



ZEOLITE SOFTENER—Employs the base exchange properties of zeolites. All hardness is removed from the water as it flows through a tank containing this mineral. Available in gravity or pressure units.



SILICA REMOVAL—Adaptable to Hot or Cold Lime Soda treatment. It reduces silica content to any degree desired . . . eliminates scale and deposits. The reagents used are low in cost and do not add soluble by-products.



Permutit's* complete service means complete protection for your plant

When Permutit prescribes feedwater treatment for your plant, you may be sure of two things: the advice is impartial and the protection is complete. That's because Permutit manufactures every type of water conditioning equipment. Why not get this certainty at your plant? Call on Permutit's expert field staff to study your water problem and suggest a solution. There is no charge for this advisory service. The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y. *Trademark Reg. U. S. Pat. Off.

NO BOILER-SCALE, CORROSION, PRIMING . . . SINCE INSTALLING PERMUTIT EQUIPMENT

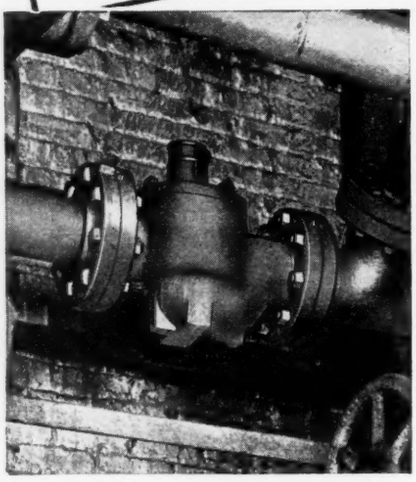
says Mr. Ray Schrawder, Chief Engineer Allentown Steam Heating Co.

ONE OF THE 10,000 STEAM PLANTS THAT RELY UPON PERMUTIT

PERMUTIT

WATER CONDITIONING HEADQUARTERS

Have we a
HENSZEY METER
for your job?



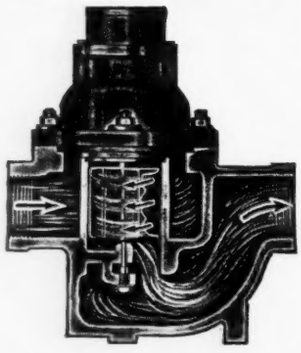
The answer is YES!

HENSZEY
FEED WATER
METERS

are equally accurate at high or low flow, on centrifugal duplex, triplex, or reciprocating pumps, and at all pressures. Their accuracy is not affected by hot, dirty blowdown. Sizes from 10 g.p.m. to 1200 g.p.m. cold water steady flow rating, pipe connections ¾" to 6". Can be calibrated in gallons, pounds, or cubic feet at any specified temperature.

Send for complete information

HENSZEY COMPANY
Dept. D12, Watertown, Wis.



Water enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register. No close clearance—less wear—continued accuracy.

HENSZEY

plant, to succeed James C Lenahan, who died recently. Mr Lenahan, an employee of the company for 36 years, had been purchasing agent since 1918. Mr Craig, a native of Scotland and an American citizen since 1920, joined Link-Belt in 1916 in the Philadelphia plant purchasing department.

WATER TREATMENT CO OF AMERICA, Pittsburgh, Pa., announces that Mr George Volkmuth, 119 Blaine St, Syracuse, N. Y., is now its distributor in that area for company products and services. Company also announces appointment of V L Francisco as general sales manager.

W B Simons, Charlotte, N. C., has been made a representative of COCHRANE CORP in the Carolinas. Mr Simons also handles the products of Hays Corp, Spence Engrg Co, Cuno Engrg Co, Williams Gauge Co, and the Henszey Co.

WICKES BROS, Saginaw, Mich., has appointed J R Cassel Co, 110 W 42 St, New York, N. Y., as representatives for company equipment.

DOWNINGTON IRON WORKS, Downington, Pa., has entered heat-trans-equipment field. Separate division has its own building and is under direct supervision of R M Armstrong, assisted by F J O'Sullivan. T H Nelson will collaborate on metallurgical problems.

HEACON, INC, Phila, Pa., announces that they are now being represented by the following organizations: Bumstead-Woolford Co., Seattle, Wash.; Joy & Cox, Inc, Denver, Colo.; Bell & Eiss, Inc, Minneapolis, Minn.; Cochrane Engrg Co, Chicago, Ill.; Boiler Equipment Service Co, Atlanta, Ga.; and Paul B Huyette Co, Philadelphia, Pa.

ALEMITE DIV, STEWART WARNER CORP, announces appointment of Huntington Eldridge as special oil-company representative on the Pacific Coast.

GENERAL ELECTRIC CO announces several changes in personnel. W J Dorworth has been made assistant district manager of company's Atlantic district. He has been with GE since 1904, following his graduation from Penn State. R I Parker is now assistant district manager of company's Central district. Mr. Parker is in touch with power and light problems in the Chicago area, having worked there since 1919. Consolidation of Mechanical Drive and Turbine-Generator Sections at Lynn works announced. J L Kerr is named manager

Make **IMO**
part of your machine

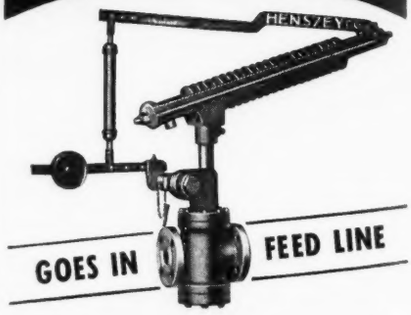
The De Laval-IMO Oil Pump

can be built into your machine and can be connected directly to a high speed member of the machine served. There are no valves, no separate bearings, no gears and no packings. Sounds simple, doesn't it?

Ask for Catalog I-86

IMO PUMP DIVISION
of the De Laval Steam Turbine Co.
Trenton, New Jersey

HENSZEY
BOILER FEED
REGULATORS



GOES IN FEED LINE

The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order — nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. D12—Watertown, Wis.

A WHOLE MONTH'S OPERATION AT ONE GLANCE

That's Why You'll Like the One-inch-per-day Chart Speed of This Instrument

THE low chart speed of cur new portable recorder gives you a 30-day record (of current or voltage) on a 30-inch chart. This makes it easy to stretch out the entire chart on your desk and see, at one glance, the spread of current or voltage, as well as the duration of maximum and minimum values.

This eliminates the annoyance of having to handle 60 ft of chart (a month's record at the minimum chart speed previously available).

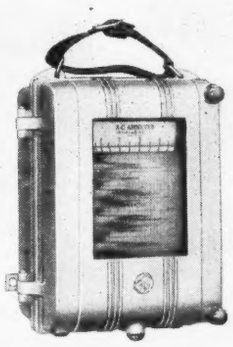
You can obtain this Type CF-1 recorder in both ammeters and voltmeters. Place your order today, and see for yourself how this instrument will simplify the work of analyzing your surveys. General Electric, Schenectady, N.Y.

IT'S INKLESS

1. Requires no attention during a month's operation.

2. No "lost" records, for there's no pen to clog and no ink to freeze or evaporate.

3. Records accurately in temperatures from −10 F to 120 F.



WHY IT PAYS TO USE RECORDERS

1. Ammeters give you a record of plant operation that will enable you to schedule work so that you can reduce peak demand—thereby reducing your demand charge.

2. Ammeters show whether or not machines are being overloaded—thus protecting against burnouts that cause costly shutdowns.

3. Voltmeters enable you to be sure that equipment is being operated at the correct voltage—thus, most efficiently.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

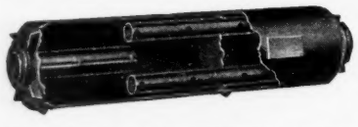
602-31-6200

No industrial area is as quiet as this mountain lake 24 hours a day, but even in busy cities the early morning hours find outside noise level at an extremely low point.

That is why more and more plants, operating night and day, are installing Maxim Silencers to quiet engine exhaust or steam blow-off.

The Light & Power Plant at La Junta, Colorado, Maxim equipped, operates 24 hours a day without disturbing nearby residents, some of whom live within 36 feet of the plant.

MAXIM SILENCERS



ARE WORTH INVESTIGATING

THE MAXIM SILENCER COMPANY
92 Homestead Ave., Hartford, Conn.

Please send details on your silencers for EXHAUST
☐ Internal Combustion engine ☐ steam engine
☐ COMPRESSOR INTAKE ☐ STEAM BLOW-OFF

Name .....

Company .....

Address .....

City..... State.....

of sales of the consilated section, with L D Whitescarver, formerly a turbine specialist, as general assistant. J F Eckel has been made supervisor of the subcontracting program of the company. He heads up GE's subcontracting policies and practices, handling relations with subcontractors as well as interested defense officials.

Correction

POWER's October report of the Centenary Celebration of John A. Roebling's Sons Co contained the following paragraph:

> "The Brooklyn Bridge, greatest monument to John A. Roebling, was started by the designer, but he was injured and died during its construction. His son, Col Washington Roebling, took over the work. He, too, finally became ill and directed the bridge building from a sick bed, watching construction through a telescope. He spent the last four months of his life dictating to his wife every detail of the finishing of the bridge. He did not live to see the bridge open".

The last two sentences in the foregoing account are seriously in error. Despite his exhausting work on the bridge, Col Washington A Roebling saw it open in 1883 and lived to contribute greatly to the success of his company and to the improvement of his community. Colonel Roebling died in Trenton, N. J., in 1926, at the age of 89.

Automatic Stokers Help Manufacturers

In six different ways an automatic coal stoker can help manufacturers of defense materials faced with the task

MEETINGS

American Association for the Advancement of Science—*Winter Meeting, December 29 to January 3, 1941 and 1942, Hotels Adolphus and Baker, Dallas, Texas.*

American Institute of Electrical Engineers—*Southern district meeting, December 3-5, 1941, New Orleans, La. Winter Convention, January 26-30, New York, N. Y. H H Henline, secretary, 39 W 39th St, New York, N. Y.*

American Society of Mechanical Engineers—*Annual Meeting, December 1-5, 1941, Hotel Astor, N. Y. C E Davis, secretary, 29 West 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*Annual Meeting, December 3-6, 1941, St. Louis, Mo.*

International Heating & Ventilating Exposition—*7th Annual Exposition, in conjunction with 48th Annual Meeting, American Society o Heating and Ventilating Engineers, Commercial Museum, Philadelphia, Pa., January 26-30, 1942.*

National Association of Fan Manufacturers—*Annual Meeting, December 4, 1941, New York, N. Y.*

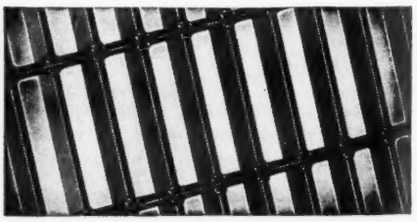
ROCKWELL Blast Gates are better designed, combine light weight with strength and are carefully machined and tested. They close airtight and have graduated dials for accurate setting and resetting.

Made in all types—slide, kwikleen, butterfly and wafer, with lever, handwheel and chain wheel control — there's a Rockwell Blast Gate for every requirement. Write for catalog 4020, W. S. Rockwell Co., 50 Church Street, New York.

★ Rockwell ★
BLAST GATES

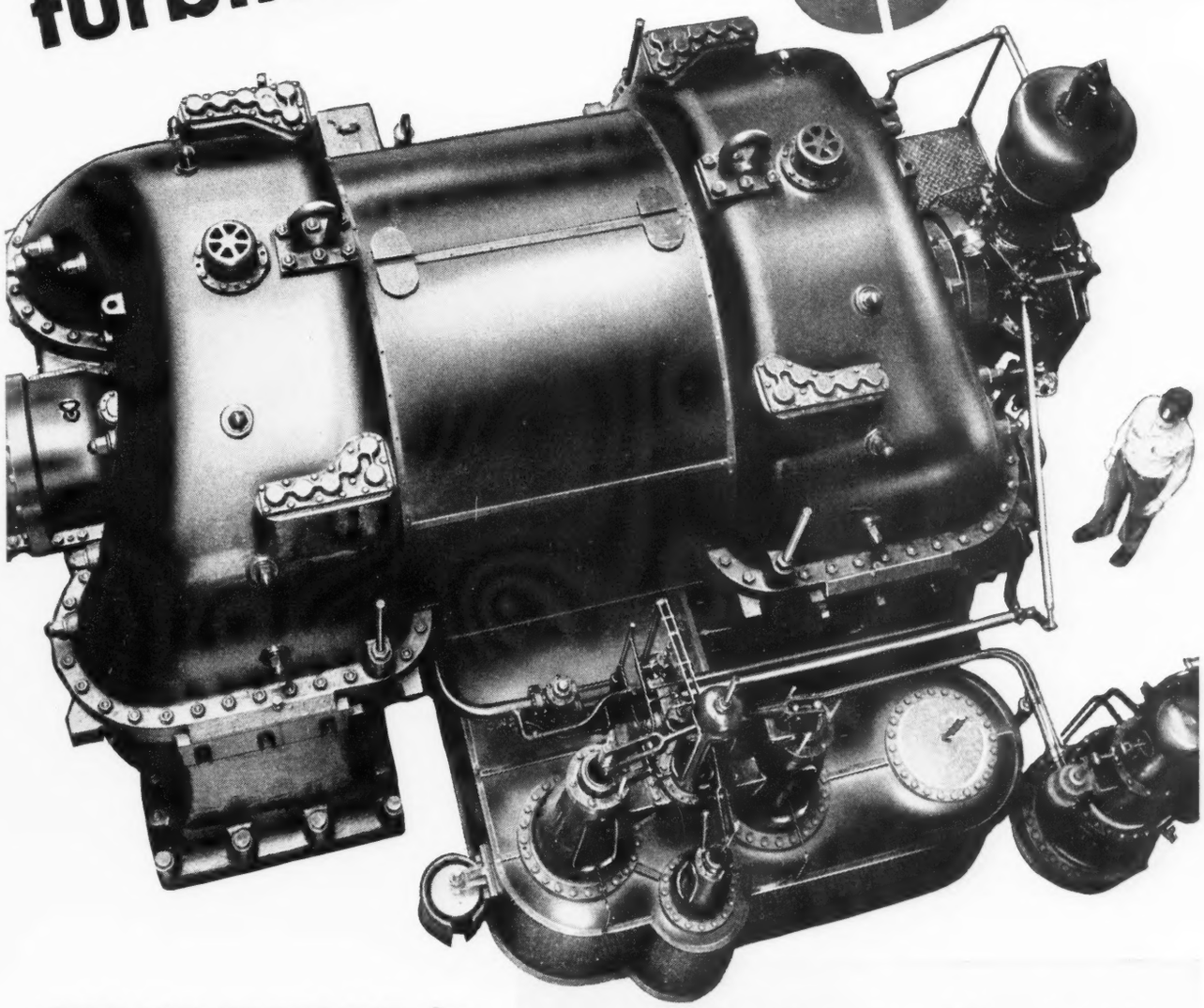
SAFE TRACTION with BATESGRATES
ELECTRICALLY PRESSURE WELDED

Non-slip, sharp top edge, self-cleaning cross bars like the ridge of a roof give you the maximum in safe traction. Other features your Batesgrate dollars buy are—maximum open area for light and air—no grooves or rough burned metal to catch grease or dirt—fillet weld, the strongest type—no cracks, joints, or crevices, therefore, easily maintained—smooth, clean appearance. Get all the important details from Catalog No. 937—Write today.



WHEN YOU NEED GRATES
Specify BATES
FOR LONG-TIME ECONOMY
WALTER BATES COMPANY
208 S. LA SALLE ST., CHICAGO, ILL.

Keep YOUR turbines on the GO



SPEED, SPEED AND MORE SPEED. Can your turbine oil stand up under today's grueling grind? The new Shell Turbo Oil can. We've tested it under the most adverse conditions. Manufacturers have given it the works, too. And they find that it's the *first turbine oil to meet all 3* of the vital requirements of modern turbine lubrication!

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

This is no time to take chances on shutdowns. Call in the Shell man today. Let him check your setup. You'll find his recommendations entirely practical—and made without obligation.

—with the turbine oil that prevents rusting

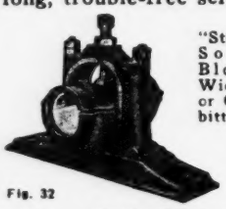
SHELL

SHELL TURBO OIL

"STANDCO"
PILLOW BLOCKS

Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.



"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Fig. 32

Write for Bulletin

STANDARD
PRESSED STEEL CO.
JENKINTOWN, PENNA.

Boston Chicago
Detroit Box 577 St. Louis
Indianapolis San Francisco

BOILER FURNACE WALLS
DO
STAND UP LONGER
when bonded with

ADAMANT
FIRE BRICK CEMENT

Write us today for literature that gives the amazing results of impartial laboratory tests definitely proving the unusually high bonding strength of Adamant. This greater strength is your assurance of longer life for brickwork, which in turn means substantial savings in time, labor and material costs. Don't forget, write now.

BOTFIELD
REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto.

of stepping up production to meet the needs of our emergency program, according to Thomas A Marsh, industrial engineer of the Iron Fireman Manufacturing Company, who says:

1. "Steady automatic firing increases boiler output. Plants all over the country have increased steam production 25 to 40 per cent by installing stokers in existing as well as new boilers.

2. "In these days of heavily taxed transportation facilities and limited supplies of some fuels, the automatic stoker greatly increases the range of coals which can be used—often making it possible to fire local coals if transportation from distant fields is restricted.

3. "An automatic stoker greatly reduces the work of firemen, decreases labor cost and often releases part of the fireman's time for other work. Automatic stokers also improve boiler-room working conditions, which is an important factor today when experienced firemen and engineers are difficult to find.

4. "Of prime importance, also, is the reliable steam supply which insures constant operation, without shutdowns and delays.

5. "They are easily adapted to existing boiler plants; no long shutdown is required to install them.

6. "Stokers burn a lower cost coal, and burn less coal because of the complete combustion and steady firing."

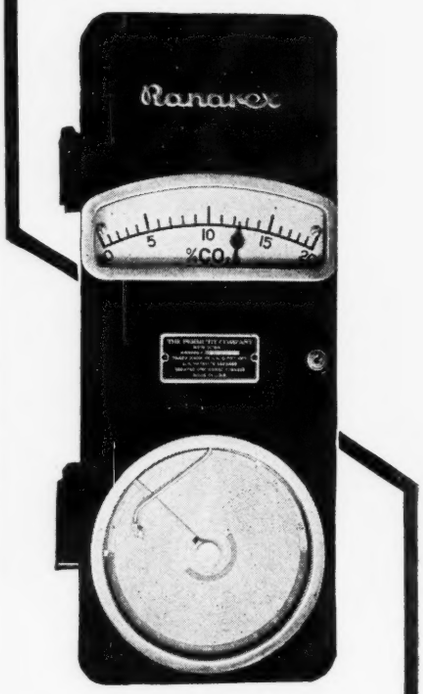
D Robert Yarnall Receives Hoover Medal for 1941

Announcement has been made that D Robert Yarnall, Mechanical Engineer of Philadelphia, Pa., has been selected as the fifth recipient of the Hoover Medal. The medal will be presented to Mr Yarnall during the Annual Meeting of The American Society of Mechanical Engineers in New York City, December 1–5, 1941, with the following citation:

"D Robert Yarnall, humanitarian, engineer, and a leader in the engineering profession, who rendered outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding refugees in this country and Europe and providing food and relief for the children and mothers of France. These distinguished public services have earned for him the Hoover Medal for 1941."

The Hoover Medal is administered by the Hoover Medal Board of Award, consisting of representatives of the American Society of Civil Engineers, American Institute of Mining and

SIMPLEST GUIDE TO EFFICIENT FIRING—



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CO_2 INDICATOR and RECORDER

★ ACCURATE — within 3/10 of 1%.

★ FAST — CO_2 stack readings in 30 seconds.

★ TOUGH — no chemicals or fragile parts.

★ ECONOMICAL — cuts fuel waste as much as 20%.

Free booklet gives complete details. Address: The Permutit Company, Dept. A, 330 West 42nd Street, New York, N. Y. *Trademark Reg. U. S. Pat. Off.

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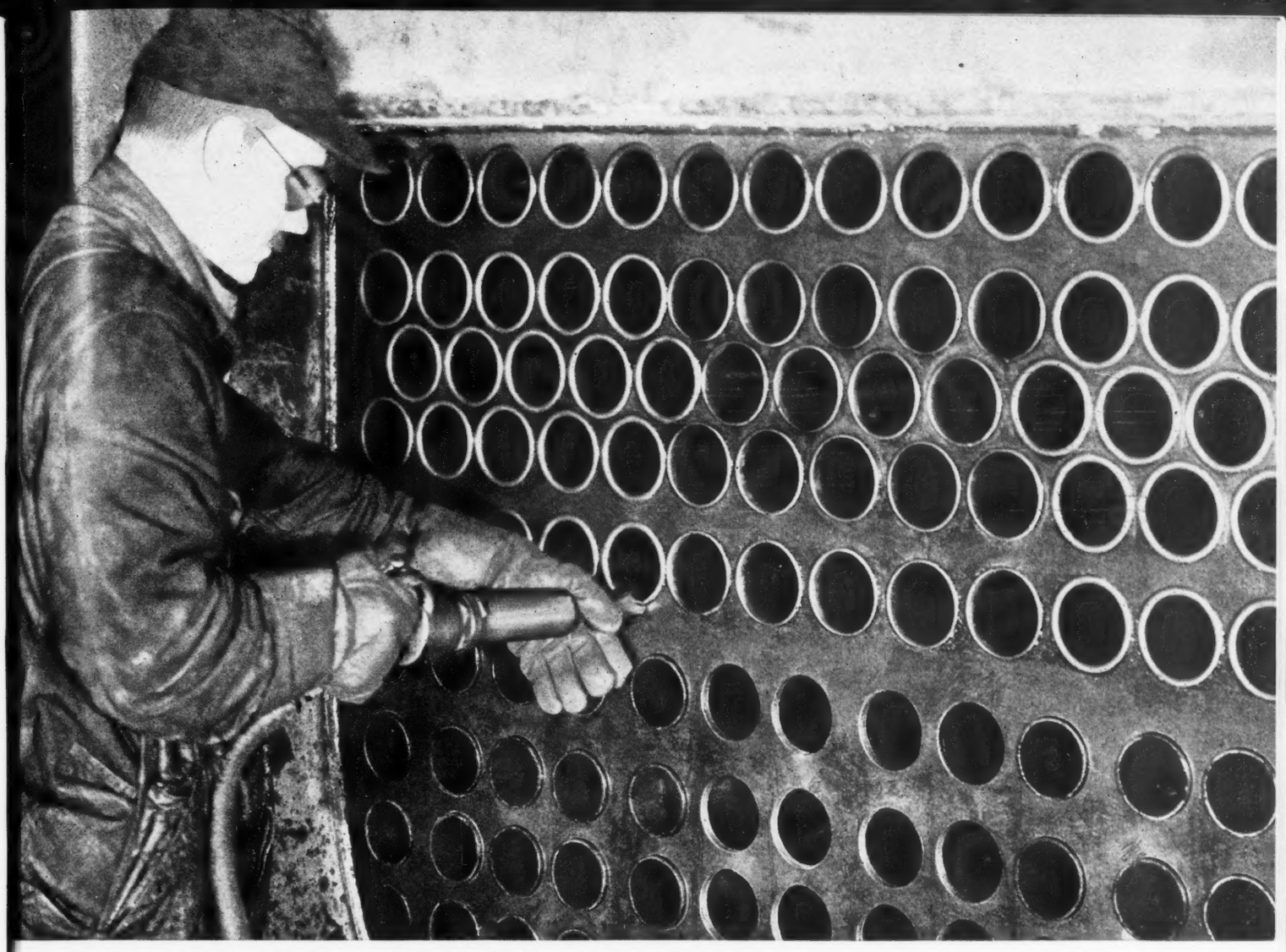


SHORTEN "SHUT-DOWN" TIME *for Tube Replacement!*

"Shut-down" time for boilers is "headache" time for operators.

How can you shorten shut-down time?

One simple and highly effective method—which, according to user reports, saves up to 30% of tube installation time—is the use of Republic ELECTRUNITE Boiler Tubes.

Because they are made by the electric resistance welding process, these tubes possess a consistent uniformity of diameter, roundness, wall thickness and ductility unattainable commercially in tubes made by other methods. They slide through sheet holes readily—expand and bead easily, quickly and uniformly all around the tube to make a tight, non-leaking joint. Re-rolling is seldom necessary.

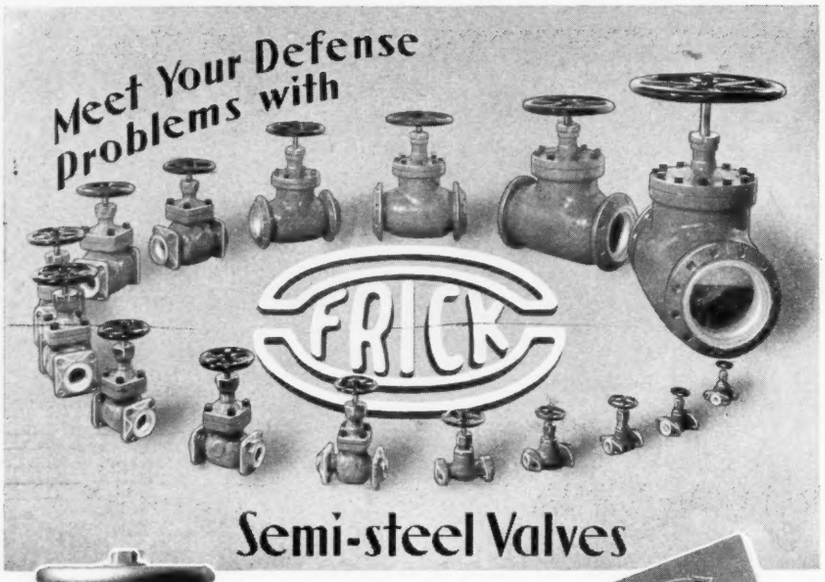
Be ready to save time when your next boiler goes down for tube replacement. Write for the full story on ELECTRUNITE and the name of your nearest distributor. Steel and Tubes Division, Republic Steel Corporation, Cleveland, Ohio.

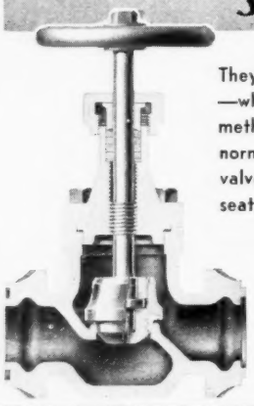
REPUBLIC STEEL — DEFENSE FOR AMERICA

Republic ELECTRUNITE

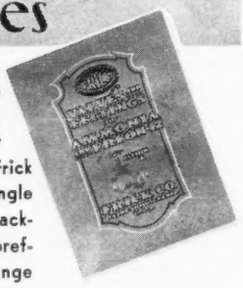
REG. U. S. PAT. OFF.

Electric Resistance Welded Boiler, Condenser and Heat Exchanger Tubes





They hold pressures up to 300 lb. gage —whether handling ammonia, Freon-12, methyl chloride, CO_2 or natural gas, at normal or low temperatures. Only in Frick valves do you get the patented high-angle seat, alloy-faced button, and easy repacking which have given them the preference for generations. . . . Full range of sizes, 1/4" to 14". Screwed valves up to 2". Stocked by Frick Distributors in principal cities everywhere . . .



Ask for Catalog K
Your copy is waiting

Write to **FRICK CO., Waynesboro, Pa.**

KEWANEE FIREBOX BOILERS

Extra Strength . . . . for Heavy Duty

Wherever heavy duty demands extra strength . . . Kewanee Steel riveted boilers are preferred. For the known strength assured by **Steel + Rivets,** supplemented by extra stout stays and braces in the boiler shell, mean many added years of service.

Ask our nearest office or write for Cat. 96 K-XII

KEWANEE BOILER CORPORATION Kewanee, Illinois

division. American Radiator and Standard Sanitary Corporation

THIS PERMANENT SEALING FEATURE COMES ONLY IN

SEA-RO NEK-SEAL PACKINGS

Once in the stuffing box and set up at proper tension, Sea-Ro Nek-Seal Packing No. 505 will function without further care.

The patented Nek-Seal fillet is an exclusive Sea-Ro feature. It prevents any escape of pressure or liquid through the gland. This packing forms a fine bearing surface when in operation, reducing wear and eliminating scoring of rods.

If high temperatures, pressures or speeds are giving you packing trouble, write us about it. There's no obligation.

SEA-RO PACKING CO., INC., WOOD-RIDGE, N. J. SEA-RO

Metallurgical Engineers. The American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. It was formally instituted on April 8, 1930, during the celebration of the fiftieth anniversary of The American Society of Mechanical Engineers, to commemmorate the civic and humanitarian achievements of Herbert Hoover and to whom the first award was made. The second recipient was Ambrose Swasey, in 1936; John Frank Stevens was the third recipient, in 1938, and Gano Dunn, the fourth recipient, in 1939. Mr Conrad N Lauer, Fellow of the ASME, and president of the Philadelphia Gas Works, created the award in 1929 with the gift of a trust fund which is held by The American Society of Mechanical Engineers.

Mr Yarnall was born June 28, 1878, in Delaware County, Pa., and shortly after his collegiate career, went to work for the Coatesville Boiler Works and allied companies as an engineer, staying with them for five years. His next position was with Stokes and Smith Company, Philadelphia, in a similar capacity, with whom he also remained for five years. In 1912 he became vice-president and general manager of Nelson Valve Co of Philadelphia, and held this position until 1918. In 1912 he organized, formed and became a co-founder with B G Waring, of the firm of Yarnall-Waring Company and has been continuously identified with the company to the present time, today holding the office of vice-president and chief engineer of the company. He is also a director and vice-president of the James G. Biddle Co and of the Pullen-lite Co, both of Philadelphia.

He served as a member of the Board of the Engineering Foundation from 1928 to 1937; he is a Fellow of The American Society of Mechanical Engineers, having served as one of its Managers from 1917 to 1920; member of Franklin Institute; Engineers' Club of Philadelphia, of which he served as President for the term of 1929–30; American Friends Service Committee and Sigma Xi fraternity.

Mr Yarnall was a member of the Board of the United Engineering Trustees, Inc, from 1934 to 1939, serving as its president for the year 1936–37. The UET is a joint agency for the four Founder Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers.

Mr Yarnall served as a member of the Commission in Europe having charge of feeding German children in 1920, being stationed there for about nine months and during the latter part of his stay in Berlin served as Chair-

13 ways TO MAKE YOUR VALVES last longer

Practical suggestions for "PREVENTIVE MAINTENANCE" WHICH WILL SAVE VALVES, eliminate waste and avoid shut downs

1 — Inspect all valves regularly

★ 2 — *AS SOON AS A VALVE LEAKS, RESEAT, REGRIND, or REWASHER IT,* otherwise it may be worn beyond repair and you may not be able to replace it.

★ 3 — IF VALVES SEAT IMPROPERLY, RESEAT them; don't force them.

4 — Clean valves before installation and install carefully.

5 — Cut pipe threads to proper length to prevent running up against seat diaphragm and ruining seat.

6 — Put pipe compound on the pipe, not in valve where it gums up working parts.

7 — Use proper size wrench on valve to prevent distortion or straining.

8 — Keep valves closed during installation to avoid entry of dirt.

9 — Support long pipe lines properly to avoid springing valve seats.

10 — Tighten all bolts or flanges on bonnets uniformly.

11 — Blow or flush foreign substances from valves immediately after installation.

12 — Use handwheel not bars or wrenches to operate a valve. Handwheel gives all leverage necessary if valve is in proper condition.

13 — Open valves or pressure lines slowly to eliminate undue strains on lines and fittings.

★ *USE DEXTER VALVE RESEATING EQUIPMENT TO PROTECT YOUR GATE GLOBE and PUMP VALVES*

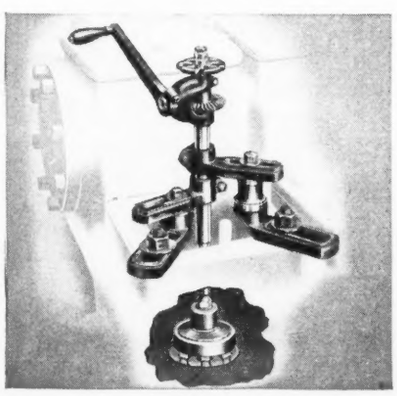
Because

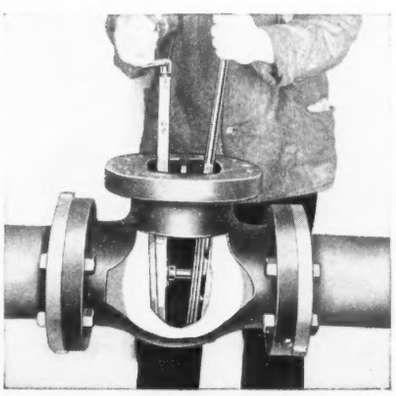
. . . it will extend the service life of your present valves and quickly pay for itself in VALVES SAVED.

. . . it assures proper reseating with little or no service interruptions; existing valves are reseated *in position* without breaking pipe connections.

. . . anyone in the plant can use the "DEXTER" and make valve seat and disc absolutely tight in a few minutes.

. . . cost of the equipment is so low that no plant can afford to be without it.





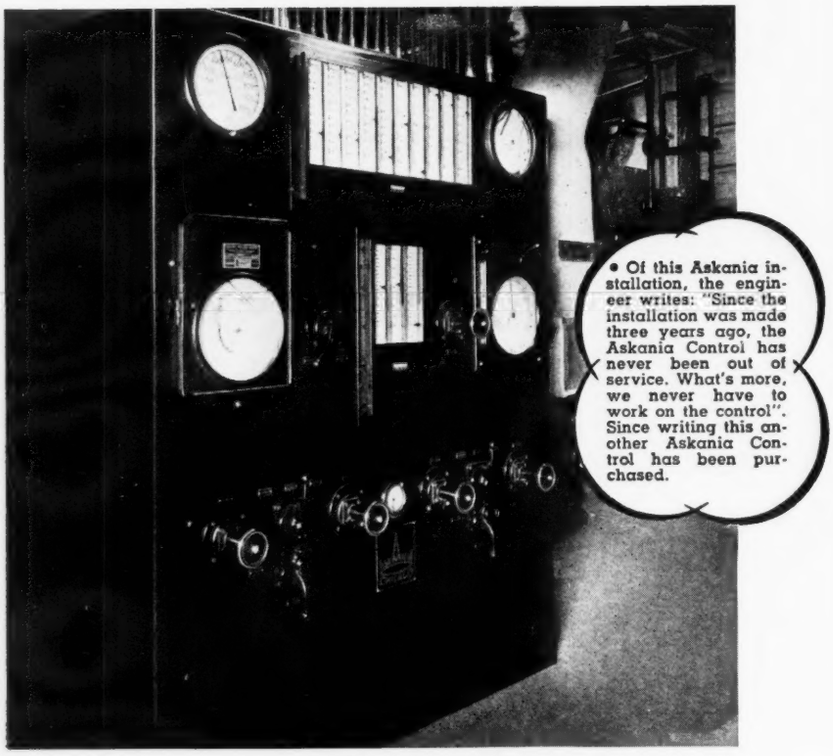
INVESTIGATE TODAY! *Mail Coupon for Details*

LEAVITT MACHINE CO., ORANGE, MASS.

Kindly send me (without obligation) full information on Dexter Valve Reseating Machines for GLOBE, GATE and PUMP VALVES.

NAME..... **POSITION**.....

COMPANY..... **ADDRESS**.....


• Of this Askania installation, the engineer writes: "Since the installation was made three years ago, the Askania Control has never been out of service. What's more, we never have to work on the control". Since writing this another Askania Control has been purchased.

"I couldn't believe that a Combustion Control could be so trouble-free!"

● So exclaimed a practical operating engineer.*

"It does a grand job of controlling combustion," he said, "but it isn't so much the job it does as the way it keeps on doing it without tinkering and adjustment."

Yes, "without tinkering or adjustment"! *Any* practical man who has had the opportunity to use Askania Control will tell you that this is the attribute which distinguishes it.

This is an *inherent* attribute of the exclusive Askania Jet Pipe Principle. It means not only greater accuracy of control, but also far greater simplicity that spells trouble-free operation. Let us show you the advantages and economies of Askania Jet Pipe regulation in terms of *your* plant conditions.

* *After having Askania Control in operation for several months in his new plant.*

ASKANIA REGULATOR COMPANY
Corner 16th and Michigan Chicago, Ill.

ASKANIA *Combustion* **CONTROL**

man of that Commission. In 1924 he was again sent to Germany under the auspices of the American Friends Service Committee and the General Allen Committee, being staitoned there for about three or four months. In June, 1938, he and Mrs Yarnall were sent by the American Friends Service Committee to Vienna to aid the refugees who were pouring into the Quaker office there. They stayed in Vienna for three months. In December, 1938, in company with Rufus M Jones and George A Walton he went to Berlin, under the auspices of the American Friends Service Committee, to interview German officials in regard to possible aid to be given to refugees in emigrating. They were in Germany about two weeks.

Again, in January 1941, Mr Yarnall, under the same auspices, went to England to investigate the relief situation there and to assist in expediting shipments of milk and medical supplies for the support of the AFSC relief program in France for the relief of children and mothers; all of this in cooperation with the Red Cross.

Mr Yarnall is now Chairman of the Refugee Section of the American Friends Service Committee.

Largest Magnetic Speed Drive Ordered for Mystic

One of the largest magnetic variable-speed drives yet to be applied to an induced-draft fan has been ordered by the Boston Edison Company for its new Mystic station at Everett, Mass., it is announced by the Electric Machinery Mfg Company, Minneapolis, Minn., builders of the unit.

The magnetic drive will be rated 1250 hp, 858 to 90 rpm and will be operated by a 1250 hp, 885-rpm squirrel-cage induction motor.

The induced-draft fan which the big new unit will control will serve the station's No. 1 steam generator.

Consulting engineers on the project are Jackson and Moreland of Boston and New York.

An Omission

The equipment list on page 85, October, 1941 POWER, failed to state that the blowdown valves in the Henry Disston & Sons boiler plant were furnished by the Yarnall-Waring Co, Philadelphia, Pa.

PROOF . . . THAT K.A.T. . . . PIONEER OF THE MODERN METHOD OF WATER TREATMENT . . . IS THE MOST EFFECTIVE TODAY!

For more than half a century, efforts to remove impurities from feed water have largely been focused on chemical treatments. After all the work expended in that direction, the most that can be said today is that some chemicals will remove other impurities. No single chemical or combination of chemicals has yet been discovered that will successfully treat all waters, or that does not have disadvantages, or that does not require continual analyses and modifications with each change in composition of the water.

Meanwhile, research along entirely different lines has developed a method of treatment that has proven successful with *all* kinds of impurities in water and without the complexities and uncertainties of chemical treatment. This method is the organic colloidal method which has come into such prominence lately.

Millions of Organic Magnets

You know how white corpuscles clear up bacterial infection in the blood stream by surrounding the impurities so they can do no harm. The minute particles of K.A.T. act similarly toward scale-forming impurities in feed water by sheathing them and preventing their deposition. This action is strictly physical and not dependent on chemical principles.

▲ ▲ ▲

The Plus Values of K.A.T.

But K.A.T. does more than just prevent scale. It has a double-barreled action against corrosion. Free gases are adsorbed, and a protective film is formed over the metal.

▲ ▲ ▲

20 + 14 YEARS OLD

A full generation of research and science is behind K.A.T. . . . Conceived 34 years ago . . . tested, improved and perfected for 20 years before being placed on the market —and now with 14 years of performance records to prove its benefits.

K.A.T. Results make Headlines

K.A.T. properties are not theoretical . . . they are FACTS . . . proven by innumerable experiences. Users read like a Who's Who of American Industry. Here are a few "headlines" which quote actual results with K.A.T.—details furnished on request.

"Washing outages reduced by K.A.T. to ⅓ of previous frequency"

"Steam condensate purity maintained by K.A.T. eliminates necessity for distilling water"

"Foaming from using various waters eliminated by K.A.T. on locomotives"

"Large steam plant credits K.A.T. with 5% blow-down saving"

"Water still operates one year without de-scaling despite use of hard well water"

"Textile plant uses K.A.T. without case of dye color spoilage"

"K.A.T. SPECIFIED BY LEADING WATER STILL MANUFACTURERS TO THEIR CUSTOMERS"

Takes "Red Tape" and Trouble out of Water Treatment

Nothing could be simpler than the application of K.A.T. No need for continually analysing water. . . . No careful proportioning of several chemicals. . . . No elaborate costly equipment. K.A.T. is a liquid, comes ready to use . . . is moderate in cost . . . and the results are guaranteed.

▲ ▲ ▲

Booklet Tells All *Send for copy*

Every plant engineer should know about K.A.T. . . . a proven success in power and heating boilers, stills and evaporators . . . used by leading industrials. Write for booklet and technical data . . . sent FREE when requested on your company stationery . . . also ask for address of our nearest field engineer.

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K.A.T. ALL-COLLOIDAL WATER TREATMENT

A SERVICE for Engineers who want "The Right Valve for the Job!"

RIGHT now many engineers are faced with a problem. To get the kind of performance they want involves SPECIAL design and construction in the equipment going into power, process and heating jobs: but to get quick delivery and reasonable costs, wisdom dictates use of STANDARD items wherever possible.

It is in such situations that DAVIS can immediately come to your assistance with what is believed to be the broadest line of automobile valve specialties in existence today. Features which you might consider "special" are often found to be standard with DAVIS, making unnecessary a long wait for special equipment to be designed and built. *For your own protection, always make it a habit to check with Davis on any automatic valve need!*

Do you have the latest DAVIS Bulletins?

DAVIS REGULATOR CO.
2540 S. Washtenaw Ave., Chicago

Without obligating me, please MAIL literature describing:

- ☐ Pressure Regulators and Pump Governors (including service and capacity charts).
- ☐ Pressure Relief, Back Pressure, and Exhaust Relief Valves.
- ☐ Liquid Level Controllers for closed tanks.
- ☐ Lever and Float Operated Valves.
- ☐ Solenoid Valves for Industrial service.
- ☐ Stop and Check, Non-Return and Balanced Check Valves.
- ☐ Strainers.
- ☐ A specific problem is outlined on the attached sheet. We would appreciate your recommendations.

Name .....

Company .....

Street .....

Town ..... State .....

NEW POWER CONSTRUCTION

Construction to Come

Ala., Mobile—City plans constructing hospital and nurses home. H I Johnstone, 60 St Francis St, $1,350,000.

Arizona-California-Nevada—Bids Nov 7 by Bureau Reclamation, Custom House, Denver, Colo. furn, del 1 or 2 vertical-shaft hydraulic turbines, 1 or 2 oil-pressure governors, for Unit N-7 or Units N-7 and N-8. Boulder power plant, Boulder Canyon Project.

Arizona-California-Nevada—Bids Nov 7 by Bureau Recalamation, Custom House, Denver, Colo., 1 or 2 generators for Units N-7 and N-8, Boulder power plant, Boulder Canyon Project.

Ark., Pine Bluff—War Dept., 20 St and Constitution Ave, N W, Wash., D. C. plans constructing magnesium and thermite incendiary bomb plant, incl mfg and assembly plant, chemical warfare and storage depots, laboratories, shops, offices, hospital, fire and police stations, communication facilities, for Chemical Warfare Service, near here.

California—Bids Nov 24 by Bureau Reclamation, Old Post Office Bldg, Sacramento, constructing cold storage plant, Coleman Station for migratory fish control Kenneth Div, Central Valley Project.

Calif., Buttonwillow—Pacific Gas & Electric Co, 245 Market St, San Francisco, plans constructing generating facilities at Midway Steam Plant, $6,850,000.

Calif., Inglewood — North American Aviation, Inc, plans increased manufacturing facilities, incl bldgs and equip for War Dept, $954,099. Defense Plant Corp will finance.

Calif., Los Angeles—Bids Nov 4, by Housing Authority of City of Los Angeles, 1031 S Bway, constructing Estrada Courts housing 30 apartment bldgs, administration bldg, Olympic Blvd, near Sotot St, $996,000. Witmer, Watson, Risley & Alexander, 916 Architects Bldg, archts.

Calif., Richmond—Standard Oil Co of Calif. plans constructing lubricating plant, Richmond refinery. $5,000,000.

Calif., San Francisco—Bids Nov 4, by Con QM, Fort Mason, San Francisco, constructing central power plant, changes, Letterman General Hospital, in San Francisco, Presidio, Inv. W 6218-42-1.

Calif., San Francisco—Bids Nov 12, by Pub Utilities Comn, City Hall, constructing Baden pump sta at Baden, San Mateo Co, Water Dept Contr 314, for City and San Francisco Co. Over $15,000.

Calif., Vallejo—Vallejo Unified School Dist plans constructing school and school addns. $2,368,260.

Calif., Victorville—Bids Nov 12, by U S Eng, 751 S Figueroa St, Los Angeles, constructing pump station, Victorville Military Airport. Over $15,000.

Colo., Crested Butte—Bids after Dec 1, by Gunnison County Electric Assn Crested Butte, V A Morgan, supt, constructing power plant and 41-mi transmission lines. $170,000 REA allot, Rocky Mountain Eng Co, 201 Wilda Bldg, Denver, engrs.

Conn., Naugatuck—Bids Nov 6, by Fletcher-Thompson, Inc, engrs, 1336 Fairfield Ave, Bridgeport, Constructing 2-story, 80 x 180 ft, synthetic rubber factory, also tanks, pumphouse, etc., for Naugatuck Chemical Div, U S Rubber Co,

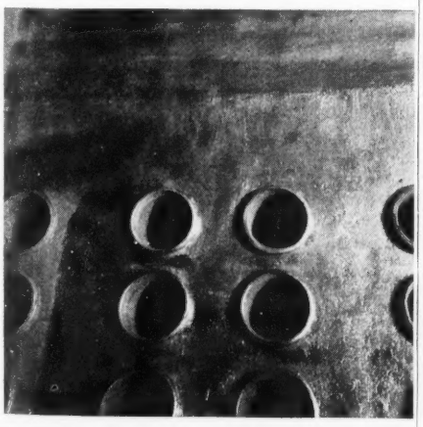
APEXIOR NEWS

A Valuable Ally of Water Preparation under High Working Pressures

The final step, in a series of operations to insure best possible condition of metal in tubes and drums of high-pressure boilers, is the application of APEXIOR coating.

In a large number of boilers now operating in the range from 600# to 1350# W. S. P., APEXIOR is considered a valuable partner of evaporated make-up, deaeration and chemical treatment. Users agree that a definite improvement is effected where this *mechanical* treatment of the metal becomes one of the protective measures.

It provides a comparatively insoluble surfacing for the metal, and guards against adherent deposits due either to unexpected contamination or to excessive baking on of sludge material. As a *refinement* which builds additional security into the boiler unit with a hand brush, and provides tubes which shine up like gun barrels upon brushing for inspection, it also serves, in a less tangible but highly important sense, to improve maintenance morale.



Preparation of all boiler surfaces for APEXIOR has become a standard definition of surface condition with all boiler manufacturers. The procedure required for APEXIORIZING surfaces is now considered the best possible construction handling, whether APEXIOR is to be applied or not. The only added cost is for the APEXIOR and the application, which means a total of 6¢ to 8¢ per sq. ft. in new equipment, including removal of mill scale, material, and application. 1¼¢ per sq. ft. plus painting time once in 2 to 3 years, is the cost of maintaining APEXIOR coated surfaces.

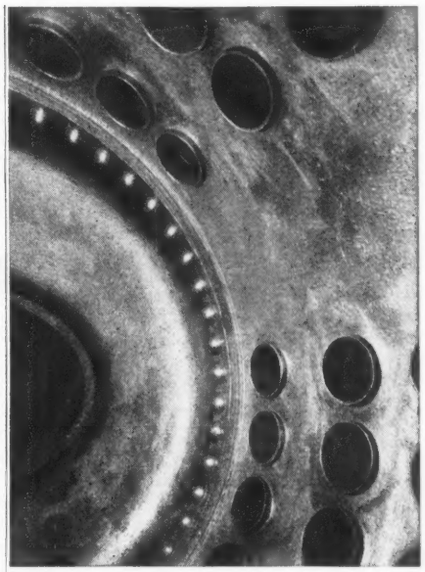
Apexior Prevents Corrosion, Lowers Cleaning Cost on Low-Pressure Boilers

APEXIOR, brush-applied to boiler metal, forms a mechanical bond with the metal and a barrier against water's corrosive action. In new boilers it prevents corrosion; in old boilers, applied after cleaning, it effectively checks corrosion . . . for periods up to 3 years between renewals.

It has the approval and recommendation of all boiler insurance companies in U. S. and Canada.

Since scale does not adhere tightly to an APEXIOR-coated surface, cleaning is much easier and is less frequently required. Under average conditions where scaling water is encountered, cleaning time can be very greatly reduced. The savings in cleaning time and in cost of operation and wear of cleaning tools, the reduction in number and length of outage periods for cleaning, are important and particularly significant during this present emergency.

Old boilers which are practically worn out and would be scheduled for immediate replacement under normal conditions, may often be kept in service indefinitely — by thorough cleaning and establishing APEXIOR as the wearing surface. Many a boiler has had a life extension by that means. Experience has indicated that any APEXIORIZED boiler which is approved for operation today at any specified working pressure, can be passed for the same pressure one year later. APEXIORIZED metal maintains the tensile strength of the date of application without crystallization. That is why some of the important boiler manufacturers make up all threaded stud or bolt assembly in boiler drums with APEXIOR.



NEW COATING MACHINE CUTS APPLICATION TIME

To reduce the cost of application, we have designed a new tube coating machine with air motor agitation, duplex air and fluid line, and forced feed to the expanding brushes (through a specially-constructed air turbine.)

In addition to saving tube coating time, the coverage has also been improved in quality and uniformity. Have us send you a bulletin containing a complete description.

Write for Apexior Bulletin 1290

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PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

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If your engineering library were limited to ONE book—

The new Fourth Edition of MARKS' HANDBOOK would give you greatest value and satisfaction as that book!

Here are thousands of facts—theory, standards, practice, and data in all branches of mechanical engineering—that you need to refer to in your work, expertly treated and arranged for quick use. Here is the sort of material you might accumulate in years of experience and many hours of reading professional books and articles—all the most frequently needed standard data and practice, and authoritative descriptions of newest developments and trends in mechanical engineering—yours, ready for use, in one convenient, volume at a reasonable cost.

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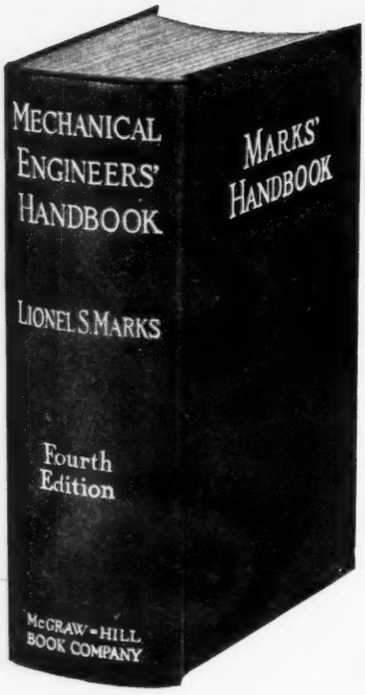

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(Books sent on approval in U. S. and Canada only.)

Naugatuck. $2,250,000 incl equip. Extended date. Defense Plant Corp will finance.

Conn., Stamford—Bids Nov 25, at office J F Connolly, com finance, Town Hall Bldg, constructing outfall sewers, sewage treatment plants and garbage incinator.

Fla., Orlando—U S Eng, P O Box 4970, Jacksonville, bids soon, constructing second Air Corps post, 95 additional bldgs. $1,250,000.

Ga., Camp Stewart—Con QM plans by Tucker & Howell, Inc, 1711 Rhodes-Haverty Bldg, Atlanta, constructing army bldgs. $3,500,000.

Ga., Savannah—Union Bag & Paper Corp of Ga., Lathrop Ave, c/o C A O'Brien, purch agt, plans constructing mill addn. $4,000,000.

Ill., Aurora—Bids Nov 10 by Sargent & Lundy, engrs, 140 S Dearborn St, Chicago, constructing superstructure power plant addn for Western United Gas & Electric Co, 50 Fox St.

Ill., Bushnell—City plans constructing light and power plant addn.

Ill., Chicago — Amertorp Corp, c/o American Can Co, 230 Park Ave, New York, N. Y., plans by R Love, 104 S Michigan Ave constructing torpedo plant on southwest side, $9,000,000 incl equip. Defense Plant Corp will finance.

Ill., Chicago—Bids Nov 14, by O E Hewitt, com pub wks constructing superstructures low lift pump sta, filter and administration bldgs, South Dist Filtration plant, vicinity E 79th St and Lake Michigan. Extended date.

Ill., Franklin Park—Continental Can Co, 4633 W Grand Ave, Chicago, plans constructing 1- and 2-story, 400x1000 ft factory, 25 St and Grand Ave. $1,500,000.

Ill., Granite City—General Steel Castings Corp, Eddystone, Pa. plans constructing plant for ordnance equip for War Dept. $3,268,400 for land and bldgs; $10,731,600 machinery and equip. Defense Plant Corp will finance.

Ill., Rockford—W F & John Barnes Co, 301 S Water St, plans acquiring site constructing, equipping plant for manufacturing shells, for War Dept. $2,000,000. Defense Plant Corp will finance.

Ind., East Chicago—Continental Roll & Steel Fdry Co, 4407 Railroad Ave, plans constructing plant for manufacture ordnance equip for War Dept. $280,090 for land and bldgs, $1,487,114 for machinery and equip. Defense Plant Corp will finance.

Ind., Evansville—City plans constructing electric light plant addn. $125,000 or more with equip.

Ind., Fort Wayne—General Electric Co, Schenectady, N. Y. plans constructing plant for manufacture aircraft equip for War Dept $8,427,471 for land and buildings, $16,584,367 for machinery and equip. Defense Plant Corp will finance.

Iowa, Cedar Rapids—Iowa Electric Light & Power Co, Security Bldg, plans 2 steam electric generating plants.

Iowa, Decorah—Interstate Power Co, Decorah plans enlarging power plant, incl substation, new steam power plant. $1,000,000.

Iowa, Iowa Falls—Central States Electric Co, Iowa Falls, plans constructing steam electric generating plant.

Iowa, Logan City—C L Strong, mayor, plans constructing light plant and dist sys. $45,000.

"BREAK" IS A LOT SMARTER THAN "BROKE"

ALTER EGO: Literally, "one's other self"—the still, small voice that questions, inspires, and corrects our conscious action.

It takes nerve to BREAK with precedent and change over to welded construction.

ALTER EGO: It takes a lot more than nerve to keep on building the way we do — when we KNOW it costs more — when we KNOW welding is so speedy and will improve the structure. That's more than nerve. It's a bad habit.

But our customers are familiar with our present methods.

ALTER EGO: That's no asset. They're more familiar with CHANGE. If they read or look, they're familiar with the *change* to welded ships, welded trucks, welded steel machines, welded buildings — every metal structure whose completion had to be stepped up—fast.

Gee! People are getting more and more welding-minded. Isn't there danger of our customers going to our competitors for welded designs?

ALTER EGO: They're looking after *their* interests, aren't they? Why not look after *ours?* Let's BREAK with habit before it's a case of being BROKE.

• •

LINCOLN SUGGESTS: The easiest way to change over to welded design is to start with the simple elements and small structures. Then gradually apply welding to the larger, more involved designs. This will start giving you the 10% to 20% savings in steel tonnage and faster construction and will prepare you for the days ahead when welding will be a *must* in the construction business. Valuable experience with welded design can be gained now by applications such as pointed out in the current series of Structural Studies. Free on request.

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THE LINCOLN ELECTRIC COMPANY
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Authoritative Information on Design • Production • Welding Equipment

REASONABLE

EASY TO INSTALL

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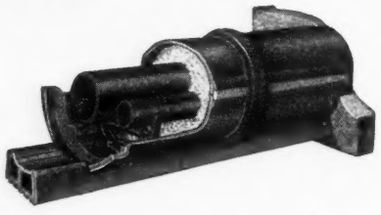


These three advantages make ADSCO-Bannon Tile Conduit a big favorite for the steam and hot water lines of army camps — naval and air bases, defense plants and housing projects.
Available with or without base drain, in sizes from 4-24" inclusive. With ADSCO Filler Insulation — a "Fiberglas" product, it makes a permanent installation of high thermal efficiency. Submit details of proposed installation for prompt quotation or write for illustrated Bulletin No. 35-67 PR.

AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

Making "UP-TO-DATE" Steam Line Equipment for over 60 years

FROM COAST TO COAST ENGINEERS SPECIFY

ADSCO BANNON CONDUIT

For Important Defense Projects

Iowa, Paullina—City plans constructing power plant, incl diesel engine, etc. Buell & Winters, 508 Ins Exch Bldg, Sioux City, engrs.

Kan., Lindsborg—G D Johnson, city engr, plans altering power plant, new generating equip. $105,000.

Ky., Ashland—American Rolling Mill Co, Middletown, O., plans constructing plant for manufacture synthetic scrap, annual capacity 600,000 tons. $842,000. Defense Plant Corp will finance.

Ky., Danville—East Ky. Rural Electric Co-op Corp, Maysville, plans constructing steam-electric generating station, near here, exten lines in eastern Ky. $2,000,000.

Ky., Hazard—Kentucky & West Virginia Power Co Inc, M C Funks, vice-pres, Hazard, plans increasing power plant capacity, also new boiler plant equip, $4,000,000. Awaiting approval State Pub Serv Comn. American Gas & Electric Service Corp, 30 Church St, New York, N. Y., engrs.

Ky., Louisville—Hycar Chemical Co c/o B F Goodrich Rubber Co, 100 W Bway, and Phillips Petroleum Co, Preston and Barnett Sts, bids soon, constructing additional rubber factory for War Dept. $2,750,000 Defense Plant Corp will finance.

La., Shreveport—Bids Nov 14, by Shreveport Housing Auth, Elamite Terrace Housing, Project La. 2-1 26 dwelling buildings, containing 270 dwelling units, etc. $1,120,000. Extended date. Neild, Somdal & Neild, City Bank Bldg, archts.

Me., Augusta—State Office Bldg Auth, Gov Sumner Sewell, chairman, Judge L M Sanborn, secy, Press Herald Bldg, Portland, plans constructing state office bldg rear of state house, $800,000.

Md., Baltimore—Bids Nov 5, by Pub Bldgs Admin, 7 and D Sts, S W, Wash., D. C. constructing 3-story office bldg for Social Security Service.

Md., Sparrows Point—Bids about Oct 29, by Bethlehem Steel Co, Sparrows Point (1st unit) constructing pump sta and water pipeline. Total est $2,000,000 Whitman, Requardt, & Smith, W Biddle and Charles Sts, Baltimore, engrs.

Mich., Detroit—Briggs Mfg Co, 11631 Mack St, soon lets contracts constructing 1- and 2-story, brick, steel, rein-con manufacturing bldg. 350x1160 ft plant for mfg turrets for War Dept. $8,000,000. Defense Plant Corp will finance.

Mich., Grand Rapids—Extruded Metals Defense Corp, Belding, plans constructing plants for manufacture extruded aluminum alloys for War Dept $2,300,000 for land and buildings, $3,966,000 for machinery and equip. Defense Plant Corp will finance.

Mich., Holland—Bids Oct 15 by Bd Pub Wks constructing power plant addn, alterations, H L Colton & P Elzinga, 222 River Ave, engrs.

Mich., Lapeer—State of Mich., Michigan Home & Training School, by L J Heenan, 609 Peoples State Bank Bldg, Pontiac, constructing brick, steel, rein-con cold-storage bldg, refrigerating equip, $57,000.

Minnesota—Western Minnesota Power Co-Operative, C R Hove, secy, Alexandria, plans constructing electric generating plants, western Minnesota, to supply power to rural dist sys, 4 to be built this year: 1 at Alexandria, and 1 at Benson, other sites not announced. $220,000 and $225,000 ea. $1,500,000 REA allot. General Engrg Corp, 2944 Cedar Ave, Minneapolis, engrs.

Minn., Benson—Stevens-Big Stone Co-Operative Power Assn, Benson, prelimi-

THE HARD WAY

Replacing damaged boiler tubes, which have failed prematurely due to scale formation, is really the hard way ... and expensive, too!

FOR SCALE-FREE BOILER TUBES

THE DEARBORN WAY

Dearborn treated boiler water can't scale. No scale . . . no expensive tube replacements . . . no time-consuming boiler shutdowns. That's the low-cost easy way!

USE THIS EASY LOW-COST WAY

Dearborn treated water prevents scale formation, thus eliminating the frequent cause of tube failure. Labor and material are not the only costs that accumulate every time damaged tubes require replacement caused by excessive scale condition. The loss of boiler horsepower due to shutdowns for repairs may well be more costly and of greater concern in these days, when production is pushed to the limit. This avoidable cost and loss of boiler horsepower can be prevented by using Dearborn Water Treatment and Engineering Service.

Dearborn Water Treatment eliminates scale trouble and provides full protection against pitting and corrosion; Dearborn Engineering Service takes the necessary steps to determine and correct the causes of steam contamination. Send for a Dearborn engineer. He will make a complete survey of your plant. Water samples will be laboratory tested . . . then a treatment recommended to meet your individual requirements, followed by a systematic test procedure and frequent check-ups to insure uninterrupted, efficient boiler operation.

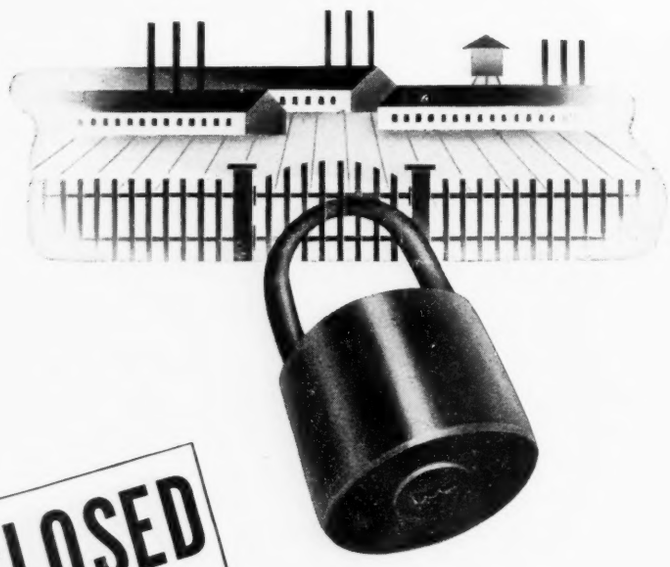
DEARBORN CHEMICAL COMPANY

Dept. D, 310 S. Michigan Avenue — Chicago, Illinois

TRADE MARK REGISTERED

Dearborn WATER TREATMENT

AND ENGINEERING SERVICE



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FOR POWER PLANT REPAIRS

HOW MUCH WOULD A *POWER PLANT SHUT-DOWN* COST YOU?

When you take a chance on untreated or improperly treated boiler feed water these days, there's even more at stake than costly repairs. You risk a power shut-down that may cripple your entire plant and add weeks to your production schedules!

That's why so many plant engineers are turning to FERRISUL (anhydrous ferric sulfate) as one sure, safe, and easy way to rid boiler feed water of silica and organic substances—WITHOUT danger of leaving scale-forming or corrosive residuals.

Ferrisul's floc is highly adsorptive, forms immediately, settles rapidly, is stable over the entire pH range above 3.5, leaves no harmful coagulant residuals. Dry and free-flowing, Ferrisul is easy to handle and requires no expensive storage tanks. It can be transferred on any standard conveyor system and introduced into the treatment in standard dry feed machines or solution feeders.

Write today for booklet which gives complete technical details. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

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Refer your water treating problems to Monsanto's experienced technical department. Monsanto manufactures a full line of water treating chemicals, is in a position to give sound, unbiased advice on your particular needs.

FERRISUL
FOR BOILER FEED WATER TREATMENT

LET'S GO! U.S.A. KEEP 'EM FLYING!

MONSANTO CHEMICALS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

nary plans constructing generating plant. REA. General Engrg Corp, 2944 Cedar Ave, Minneapolis, engrs.

Minn., Crosby—War Dept, 20th St and Constitution Ave, Wash., D. C., plans constructing magnesium plant $5,000,000.

Miss., Biloxi—City plans constructing impr water sys, well, reservoir, pump, stations, mains, etc. $190,000.

Neb., Omaha—Farm Credit Admin, L W Powers, gen agt, 206 S 19 St, 5-story office bldg. Didge St from 19 to 20 Sts. $800,000.

Neb., Wahoo—War Dept, 20 St and Constitution Ave, Wash, D. C. plans constructing Nebraska Ordnance plant for bomb loading.

N. H., Laconia—Scott & Williams Inc, 266 Union St, receiving bids, constructing brick, steel factory for manufacture aircraft equip, for War Dept $809,331. Defense Plant Corp will finance. E Beyster, General Motors Bldg, Detroit, Mich, engr.

Nev., Ely—White Pine Co, c/o County Clerk, Ely, plans constructing central heating plant for county bldgs. $60,000, Applied for DPW loan.

N. J., Cape May—Northwest Magnesite Corp, Farmers Bldg, Pittsburgh, Pa. plans constructing magnesite factory. $1,000,000.

N. J., Holland—N J Power & Light Co, 38 Main St, Flemington, plans constructing brick, steel, power pl addn. E M Gilbert Eng Corp, 412 Washington St, Reading, Pa., engr.

N. J., Jersey City—Bids Nov 7 by Erie R R Co, J W Smith, C H Engr, Midland Bldg, Cleveland, O., constructing drain repair yard, concrete, steel boiler shop, machine shop, mooring racks, etc. 7 W and Hudson Rvr, $33,000.

N. J., Livingston—City plans constructing 9-mi sanitary sewers, various streets, force main and pump sta, near Livingston Center, $85,000. T F Bowe 110 William St, New York, N. Y., engr.

New York and Ontario—Federal Power Comn, 18th St and Pennsylvania Ave, Wash., D. C., and U. S. Eng 1 and Douglas St N W, Wash., D. C., and General Eng Dpt of Transport, Ottawa, Ont., Canada, making preliminary plans constructing concrete dam, power plant, approx 21-mi canal at Barnhart Island in Massena, N. Y.; concrete dam, power plant, approx 7-mi canal, Crysler Island near Waddington, N. Y.; job extends from Waddington, N. Y. to point opposite Cornwall, Ont., on American side. Lt Col A B Jones, Massena, N. Y. U S Engr. J P Crowden, 251 Orchard Dr, Pittsburgh, Pa., consult engr.

N. Y., Ballston Spa—Bids Oct 29, by Bd Village Trustees constructing outfall sewer, c i force main and sewage pump, sewage disintegrator, improved sewage pumping station, extended date. Solomon & Kies, 257 Bway, Troy, consult engrs. D D Hall, village clk.

N. Y., Brooklyn—President Brooklyn, Boro Hall, plans replacing pump sta, Neptune Ave and West 29th St, $187,000.

N. Y., Buffalo—Universal Smelting & Refining Corp, 2548 Elmwood Ave, plans constructing smelting plant. Over $5,000,000.

N. Y., Flushing—Bd Higher Education, 695 Park Ave., New York, plans constructing boiler house, alterations, addns, Queens College. $149,500.

N. Y., New York—Bids Nov 7, by Dpt Pub Wks, Municipal Bldg, Contr 4, structures and equip. Contr 5, piping, 26 Ward

"Welding takes less time when the boss buys MIDWEST FITTINGS"

"The boss says us pipe welders are a big 'headache' to the Estimating Department. On one job we beat the estimated time and he makes real money . . . but on the next job like it (and for no reason), we run way over the time.

"The reason is there, but he hasn't seen it—yet. We cut the welding time and save money whenever he gives us Midwest Welding Ells. The dimensions of these Midwest fittings are always 'right on the nose' . . . and so is the angle. We can cut all our pipe in advance according to the drawings and know it will go in place easily and quickly without any 'phenageling'.

"Another thing we like about the Midwest Ells is that they are really round . . . and the wall thickness is the same all around. And don't let anyone tell you this doesn't save time and make better welds."

You, too, will appreciate the many advantages of Midwest Welding Fittings. Specify them on your next welded piping job.

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

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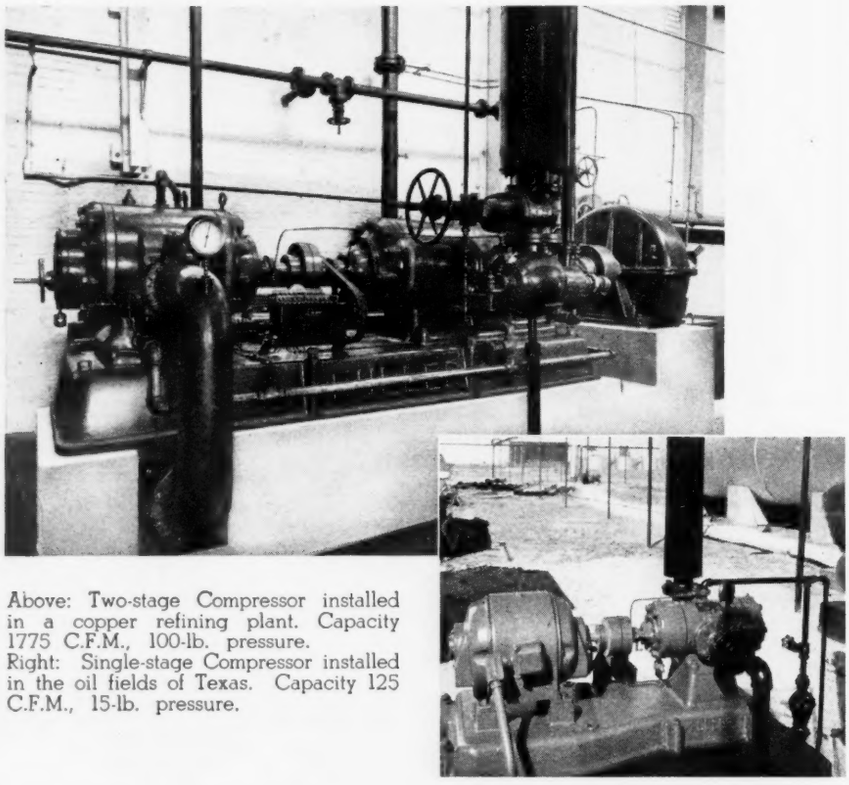

Above: Two-stage Compressor installed in a copper refining plant. Capacity 1775 C.F.M., 100-lb. pressure.
Right: Single-stage Compressor installed in the oil fields of Texas. Capacity 125 C.F.M., 15-lb. pressure.

Single and Two-Stage Units . . . Capacities to 1800 C.F.M., 125-Lb. pressure

There's a Fuller Rotary Compressor that will meet your requirements. Built for direct motor or gas-engine drive without speed reduction, and for geared-turbine drive, they offer dependable service, keep maintenance at a minimum . . . in the long run, lower operating costs. Original capacities maintained for the life of the machine, plus many other inherent advantages, warrant your thorough investigation.

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C-63

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

Sewage Treatment Works. Bids 10/8 rejected.

N. Y., Rochester — Symington-Gould Corp, 20 Symington Pl plans constructing plant for manufacture ordnance equip for War Dept. $499,005 for land and buildings, $757,100 for machinery and equip. Defense Plant Corp will finance.

N. C., Charlotte—Standard Ice & Fuel Co, J G Boyce, pres, 700 W 9 St, plans constructing cold storage plant, steel concrete. $60,000.

N. C., High Point—E M Knox, city mgr, plans constructing auxiliary steam plant. $1,500,000. Will apply for PWA loan and grant. W C Olsen, 5 Exchange Pl, Raleigh, engr.

N. C., Wilmington—City plans $750,000 bond election Dec 2, incl expanding city water supply, $525,000; incinerator $100,000; extend storm sewers in area of Greenfield Lake, $75,000; extend sewage sys same area, $35,000; purchasing, devel Robert Strange, playground and Marine Hospital, $20,000. Total est $3,500,000. J G Wallace, city manager.

Ohio—Federal Wks Agency, 18 and F Sts, N W, Wash., D. C., plans constructing Berlin reservoir and dam on Mahoning River near Shillings mill south of Lake Milton, $2,000,000.

Ohio, Canton—City plans impr W W Sys, impounding reservoir, water treatment plant, pump equip. $2,672,991.

Ohio, Canton—Republic Steel Corp, C A Thayer, ch engr, Republic Bldg, Cleveland, plans constructing steel plant. $5,140,500. Defense Plant Corp. will finance.

Ohio, Cleveland—City plans constructing 10 mg rein-con reservoir $275,000, 40 mg pump and boilers, $525,000, 75 mg pump and boiler, $220,000, feeder mains up to 48 in. $1,425,000, water mains, $1,023,360, mains, cross connections, fire hydrants, etc. $1,211,500; rein-con reservoir, watermains, south of Chardon Rd, $625,000. G W Hamlin, 104 City Hall, engr.

Ohio, Cleveland—Republic Steel Corp, C M White, vice pres in charge operation, C A Thayer, ch engr, Republic Bldg plans constructing two 1275 ton blast furnaces, 2 batteries of coke ovens of 75 ovens each, by-product recovery plant, additional dock facilities, etc. $14,000,000. Defense Plant Corp will finance.

Ohio, Gallipolis—Buckeye Rural Electric Co-operative, Inc, J R Lusher, supt, Gallipolis, plans constructing electric generating plant. $250,000 REA allot.

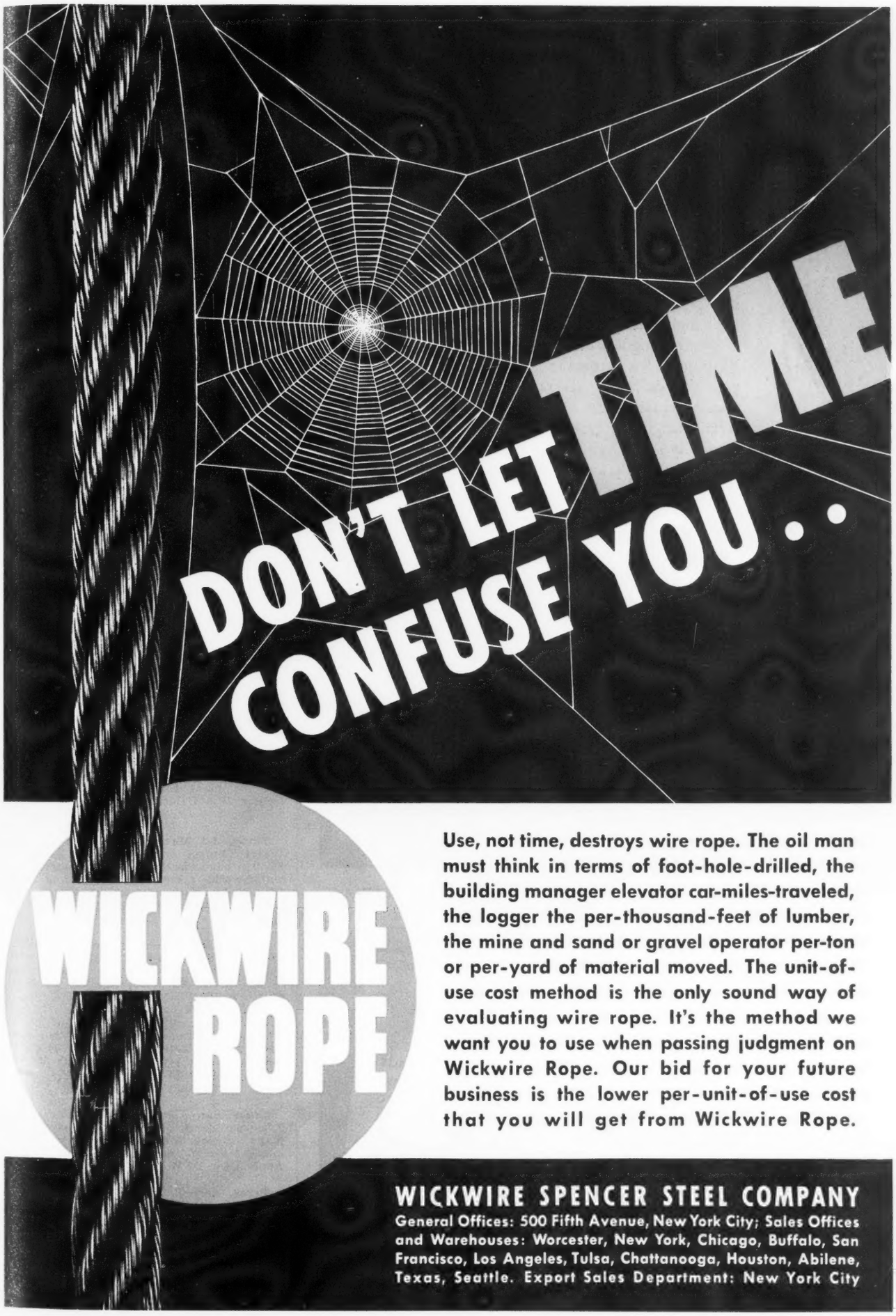
Ohio, South Point—Atmospheric Nitrogen Corp, subsidiary of Allied Chemical & Dye Corp, 61 Bwy, New York, N. Y., plans constructing chemical mfg plant, known as Buckeye Ordnance Works, for War Dept. $22,000,000. Defense Plant Corp will finance.

Ohio, Springfield—City plans constructing W W impr, reservoir, pump equip, filters, treatment, plant addition. $1,000,000. Applied for federal grant. W E Lucas, city engr.

Ohio, Warren—Republic Steel Corp, C M White, vice pres in charge operations, C A Thayer ch engr, Republic Bldg, plans constructing 61 coke ovens, wharf, coke handling equip, coke screen system, by products bldg, sintering plant, $2,000,000. Defense Plant Corp will finance.

Okla., Okla. City—Bids October 28 by E Simon, city clk, constructing water filtration and pump pl ext. $1,934,000. V V Long & Co, Colcord Bldg, Okla. City, engrs.

Ore., Troutdale — Aluminum Co of



Use, not time, destroys wire rope. The oil man must think in terms of foot-hole-drilled, the building manager elevator car-miles-traveled, the logger the per-thousand-feet of lumber, the mine and sand or gravel operator per-ton or per-yard of material moved. The unit-of-use cost method is the only sound way of evaluating wire rope. It's the method we want you to use when passing judgment on Wickwire Rope. Our bid for your future business is the lower per-unit-of-use cost that you will get from Wickwire Rope.

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to specify Macwhyte Elevator Cables

No matter what type of elevator installation you have, there are Macwhyte Cables for it that will give you low-cost-per-car-mile service.

Whether you are installing new elevators or replacing the cables on your present elevators, specify Macwhyte. Macwhyte Cables both PREformed and non-preformed have been recognized for years for their high quality and low-cost-per-car-mile service.

Because fatigue is the arch-enemy of elevator cables, PREformed has become more and more popular and profitable on hoists. The process of PREforming reduces internal stresses and friction in the cable, helps it resist fatigue. PREforming also increases the cable's flexibility so that it hugs the sheaves, operates smoothly, and reduces slippage.

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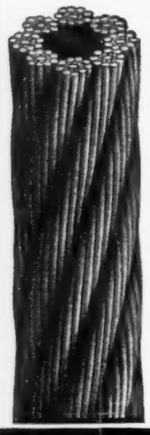
Macwhyte
Special Traction



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SPECIFY MACWHYTE PRE-FORMED . . . made from selected steel most suitable for elevator cable construction . . . PREformed . . . and thoroughly lubricated to provide continuous protection against corrosion and friction . . . available in both 6 x 19 and 8 x 19 constructions.

MACWHYTE COMPANY, 2944 Fourteenth Ave., Kenosha, Wis. • *Manufacturers of wire rope to meet every need—left-&-right lay braided slings—Stainless Steel wire rope—Monel Metal wire rope—Aircraft cable, Aircraft tie-rods, and "Safe-Lock" Swaged Terminals.* NO. 582-E

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MACWHYTE ELEVATOR CABLES

PREformed FOR per-car-mile *BEST PERFORMANCE*

CRANE ROPES
Put MONARCH WHYTE STRAND PREformed CRANE ROPES to work—for safety and economy. Ask for details.
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SLINGS
Try this new technique of heavy lifting. Your loads will be handled safely and easily. Send for literature on ATLAS Braided Wire Rope Slings.
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BRAIDED WIRE ROPE Slings
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2944 Fourteenth Avenue
Kenosha, Wisconsin

America, Gulf Bldg, Pittsburgh, Pa., plans construction 100,000,000 lb aluminum reduction plant for War Dept. $10,000,000. Defense Plant Corp will finance.

Pa., Tarentum—H H Girt, sec, 304 Lock St, plans constructing light and power plant add. $90,000. Morris Knowles, Inc, 1312 Park Bldg, Pittsburgh, engrs.

Pa., Williamsport—Aviation Mfg Corp (Lycoming Div), Williamsport, receiving bids constructing 1-story 380x425 ft steel, cement or cinder-block plant for manufacture airplane engines for War Dept. $957,249 for land and bldgs, $2,757,028 for machinery and equip. Defense Plant Corp will finance.

Tenn., Parkersville—Bids Nov 12 by Tenn. Valley Auth, Knoxville, for construction water-supply system for Parkersville Dam power plant, including drilling well, pump house, equip, etc.

Texas, Bridgeport—Town voted bonds constructing electric light and power plant. $70,000.

Texas, Carthage—City voted bonds constructing electric light and power plant. $150,000.

Texas, Corpus Christi—Bids Nov 5 by R B Fisher, supt, Corpus Christi Independent School Dist, for school building program. $1,305,660. Brock, Roberts & Anderson, Jones Bldg, architects.

Texas, Dallas—Arctic Locker and Provisions Co, McKinney Ave. Bids soon for constructing 1-story, 50x100-ft. arctic locker plant. $50,000.

Texas, Dallas—Wicker Fish & Poultry Co, 3004 Gaston St, plans by J A Pitziner, Southland Life Bldg, constructing cold-storage plant, 26x60-ft freezing room. Over $40,000.

Texas, Denison—U S Engineers, Citizens Bank Bldg, bids soon for two generating units for Denison Dam Project. $700,000.

Texas, Garland—Guiberson Diesel Engine Co, 1000 Forest St, Dallas, plans constructing mechanical work, water, sewer, gas, electric lines, air-conditioning etc, for plant for War Dept. $100,000. Defense Plant Corp will finance. J Gordon Turnbull Co, c/o owner, engineers.

Texas, La Marque—Galveston County Water Control & Improv Dist 2, plans $70,000 bond election in Nov constructing water-works system, well, elev and surface tanks, pumps, main, etc. $145,000. J H Rady, Majestic Bldg, Ft Worth, engineer.

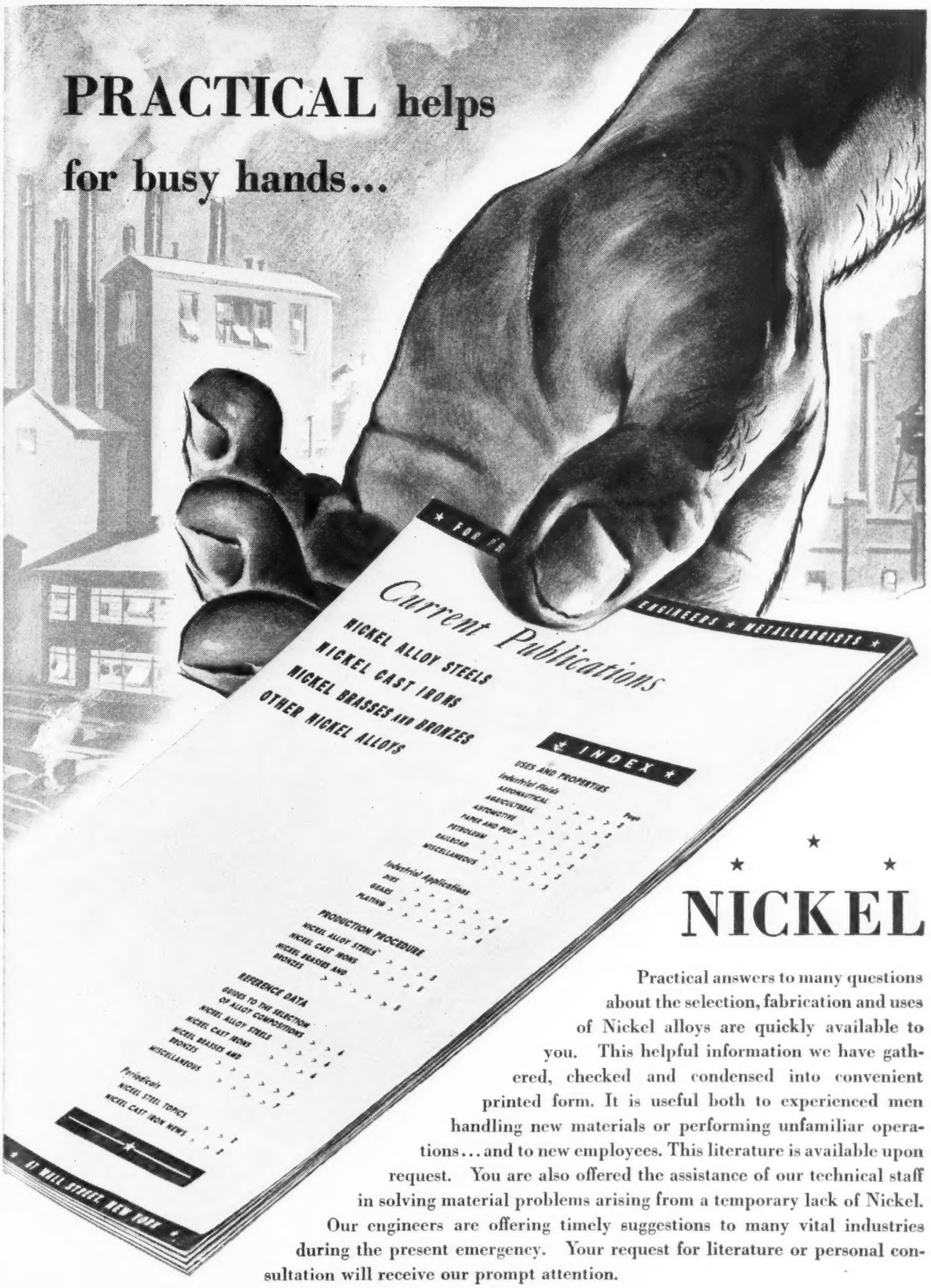
Texas, Lubbock—Sisters of St Joseph, 2605 19th St, plans by J B Roberts, Lubbock, National Bank Bldg, constructing 3-story 40x90 ft, brick, concrete hospital unit, air-conditioning. $152,280. Applied for DPW funds.

Texas, Quitman—City plans surveys constructing electric light plant and distr system. Over $40,000. Albert C Moore & Co, 2404 Smith-Young Tower, San Antonio, engineers.

Texas, San Antonio—Water Works Bd Trustees, c/o W D Masterson, president, plans constructing waterworks improvement, 3 6-mgd pumping units. $125,000. Applied for DPW funds.

Texas, Terrell—Kelpin Ice Cream Mfg Co, plans by J A Pitzinger, Southland Life Bldg, Dallas, constructing 1-story 35x100-ft and 61x98-ft L-shaped ice-cream plant, tile, steel. $40,000.

Texas, Terrell—P I Austin, town manager, plans constructing extension electric light plant and distrib sys. $70,000.



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Have you ever had a gauge glass break almost immediately after you installed it? If you have, it was probably due to installation strains which are the result of a slightly oversized glass.

To overcome these strains, PYREX and Corning Gauge Glasses are machine drawn to uniform accuracy.

In addition, PYREX Broad Red Line Gauge Glasses have these outstanding economy features: Resistance to the chemical attack of hot water and steam, resistance to heat and cold shocks, and visibility from greater distances. Ask your dealer for complete details. PYREX and Corning Gauge Glasses are stocked by leading steam and mill supply houses.

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CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

Albert C Moore & Co, 2404 Smith-Young Tower, San Antonio, engineers.

Texas, Velasco—J G Long, Bay City, plans by E. L. Shult, 5009 Fannin St, Houston, constructing 1-story, mezzanine, 50x124-ft air-conditioned theatre.

Texas, Waco—Bids Dec 1 by U S engineers, Federal Bldg, Galveston, constructing buildings, utilities, streets, etc, for basic-flying school, 6 miles NE. Tentative date. Estimated $4,000,000-$5,000,000.

Utah, Crescent Junction—Utah Magnesium Co, Crescent Junction (Grand Co), plans constructing magnesium-chloride processing plant. $1,500,000.

Utah, Marysville & Lehi—Kalunite Inc, Salt Lake City, plans constructing alumina plants. Approx $2,000,000. Defense Plant Corp will finance.

Utah, Murray—City, R B Rasmussen, city receiver, plans $200,000 bond election constructing steam-generating plant. H Bletzacker, Murray, city engineer.

Utah, Provo—Columbia Steel Co, C T Keigley, general supt, Provo, plans enlarging plant for increased production pig iron and coke. $35,000,000. Defense Plant Corp will finance.

Utah, Springville—City voted $300,000 bonds enlarging municipal power plant, extend present water system. Hugo Price, Provo, engineer.

Wash., Tacoma—Bids Nov 24 by city furnishing, installing 55,000-hp hydraulic turbine, 40,000-kw generator for LaGrand power house; two 34,500-hp hydraulic turbines, two 25,000-kw generators for Alder power house.

West Va., Wheeling—Continental Roll & Steel Fdry Co, 4407 RR Ave, East Chicago, Ind., plans constructing plant for mfg ordnance equipt for War Dept. $240,801 for land and bldgs, $1,275,006 for machinery and equip. Defense Plant Corp will finance.

Wis., Beloit—Bd Education, plans by Law, Law & Potter, 1 South Pickney St, Madison, constructing high school. $950,000. Applied for $389,000 federal funds.

Wis., Beloit—Fairbanks, Morse & Co, Beloit, plans constructing 460x660-ft brick, steel factory for Navy Dept. $5,500,000 including equip. Cunningham Bros, Beloit, engineers.

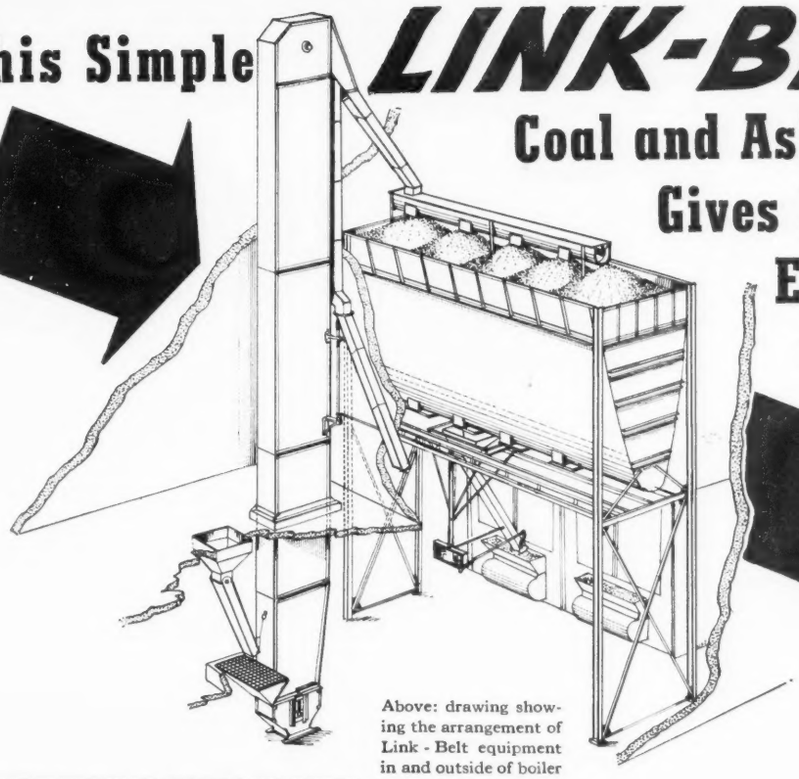
Wis., Genoa—Bids Nov 7 by Tri-State Power Coop, 312 Rivoli Bldg, La Crosse, constructing superstructure 1- and 3-story 100x200 ft concrete, brick, rein-con power-plant addition. Rural Lines, Engrs, Central Bldg, Clayton, Mo., engrs.

Wis., Merrimac—Hercules Powder Co, Delaware Trust Bldg, Wilmington, Del., plans constructing Army Ordnance plant. $65,000,000.

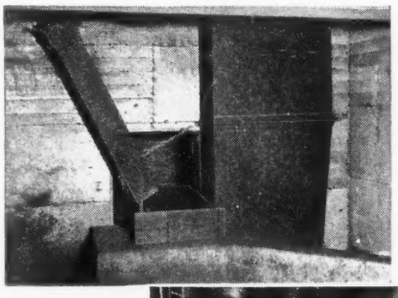
Wis., Milwaukee—Bids Nov 7 by Allis-Chalmers Mfg Co, 1120 S 70th St, constructing 1-story 500x800-ft supercharger bldg; 1-story 80x200-ft forge plant, brick, steel, for War Dept. Over $9,000,000. Defense Plant Corp will finance. Structural steel awarded to Worden Allen Co, Port Washington Rd. C E Meyer, 1120 S 70th St, engr.

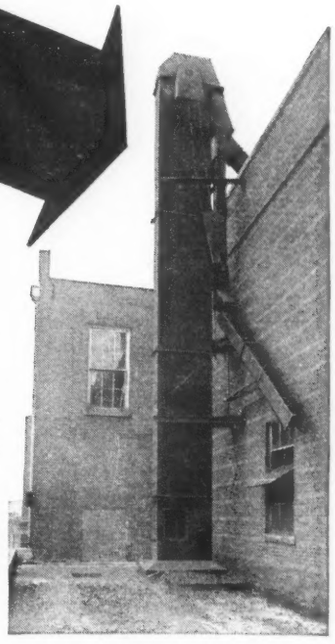
Wis., Sturgeon Bay—M W Miller & Co, receiving bids constructing 3-story, 40x106-ft brick, concrete warehouse and cold-storage bldg. W J Bernhard, Ephraim, architects.

This Simple LINK-BELT Coal and Ashes Handling Unit Gives HOSPITAL a Most Efficient, Economical Installation

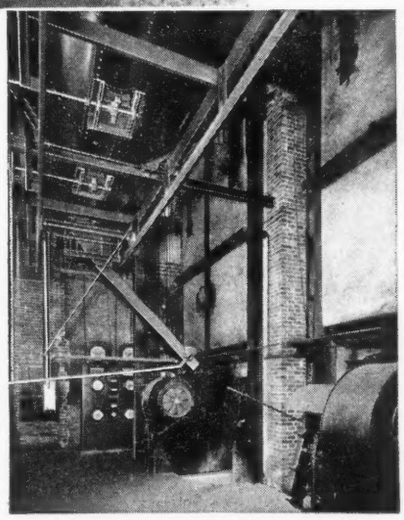


Above: drawing showing the arrangement of Link-Belt equipment in and outside of boiler room. At left is shown chute from outside hopper, feeding to bucket elevator, which handles either coal from the trucks to overhead bunkers inside the boiler room or ashes from the lower level to trucks, discharging by means of the swiveling spout shown.





Centrifugal discharge bucket elevator and receiving hopper into which coal is discharged from delivery trucks. Space under this unloading platform can also be used for auxiliary coal storage when necessary.



View inside boiler room showing the 500-lb. capacity, hand-propelled weigh larry discharging coal to stoker hopper.

● In modernizing its boiler room, a southern hospital was able to install practically all new equipment—including this simple Link-Belt coal and ashes handling system—with little alteration to the existing building. The Link-Belt unit, which consists essentially of a coal receiving hopper, bucket elevator, distributing screw conveyor to the bunker, gates and a weigh larry, has not only made an efficient and economical arrangement but has also eliminated a tremendous amount of dust that was a disturbing factor. The weigh larry enables the hospital to maintain an accurate check on the exact quantity of coal used and to maintain its boilers at maximum efficiency. Send for Link-Belt Book No. 1510 which shows many cost-reducing coal and ashes handling arrangements.

LINK-BELT COMPANY

Chicago, Philadelphia, Indianapolis, Atlanta, Dallas, San Francisco, Toronto
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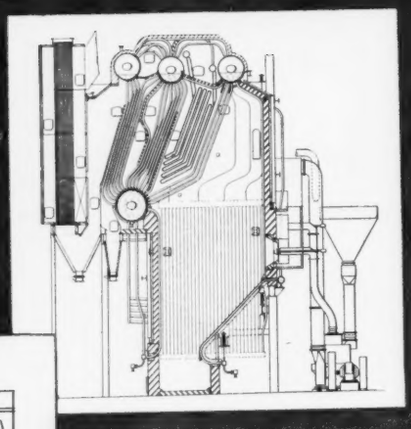
. . . Coal And Ashes Handling Equipment

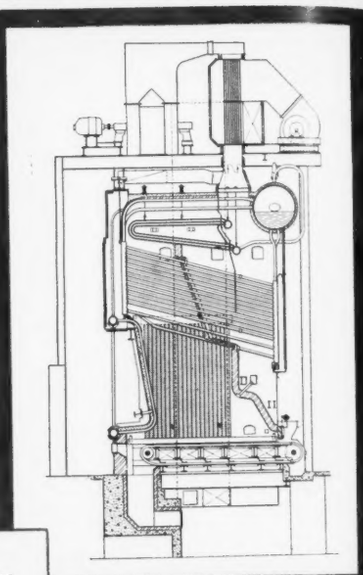
CONVEYORS · ELEVATORS · SKIP HOISTS · CRUSHERS · LARRIES · SCREENS

B&W

The fundamental soundness of B&W designs has been proved repeatedly in actual service under a wide range of operating conditions. Unequalled experience in the fabrication of boilers and related equipment, as well as pioneering and progressive engineering, have been responsible for B&W's ability to anticipate and to meet promptly the needs of modern power plants.

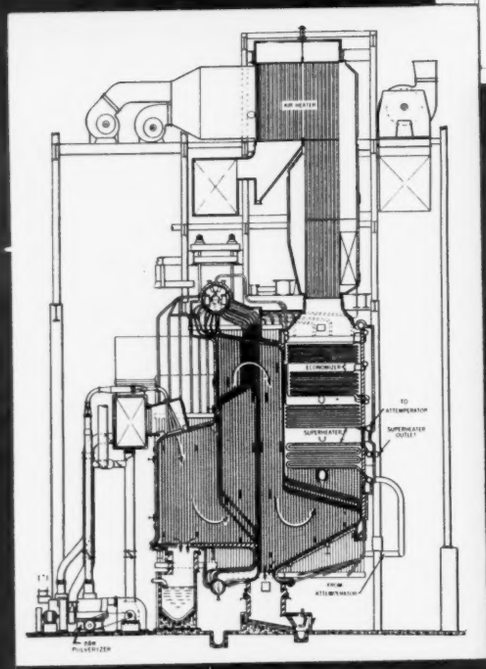
Bulletins describing Babcock & Wilcox Boilers and component equipment are available on request.



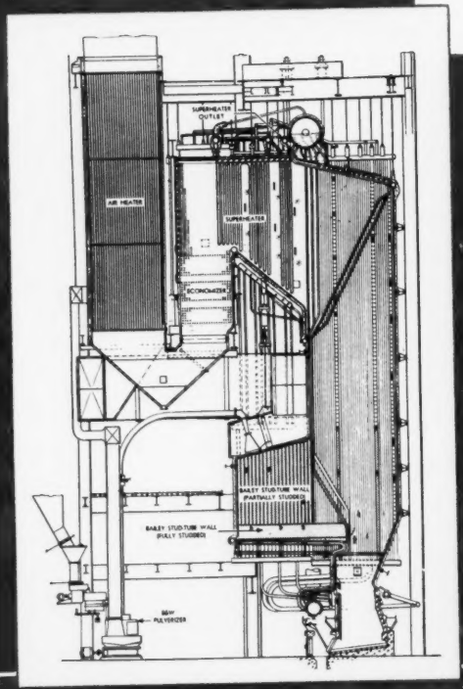


B&W Cross-Drum Boiler

Delivers dry steam at high ratings. Tubes, being straight, can be readily inspected internally, and can be easily replaced if necessary.



B&W Open-Pass Boiler for Central Stations

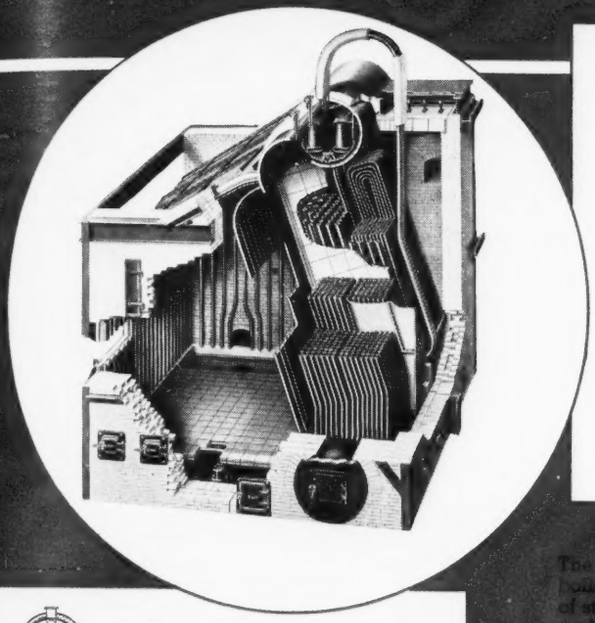


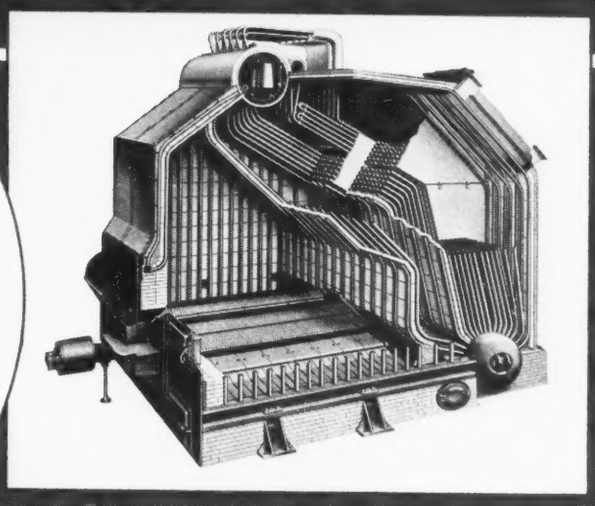
B&W Radiant Boiler for Central Stations

BABCOCK &

THE BABCOCK & WILCOX CO.

anticipates and meets all steam generating requirements

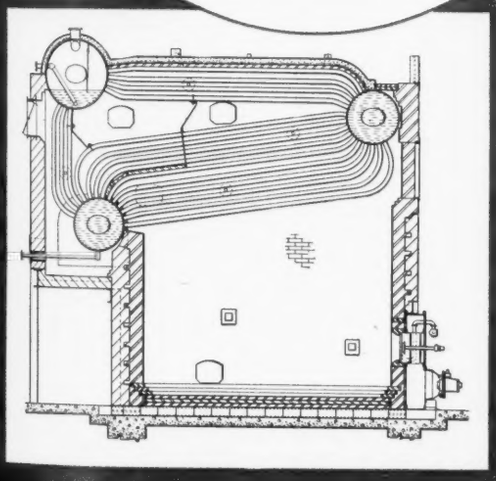




B&W Integral-Furnace Boiler

The Integral-Furnace Boiler is a completely co-ordinated steam-boiler unit, built in capacities ranging from 10,000 to 250,000 lb. of steam per hr. It is adoptable to any fuel and method of firing, and will deliver steam at the pressures and temperatures demanded by the most up-to-date and efficient prime movers.

Left, cut-away view of an Integral-Furnace Boiler designed for oil or coal firing (or both). Right, a stoker-fired unit, for capacities up to 35,000 lb. of steam per hr.

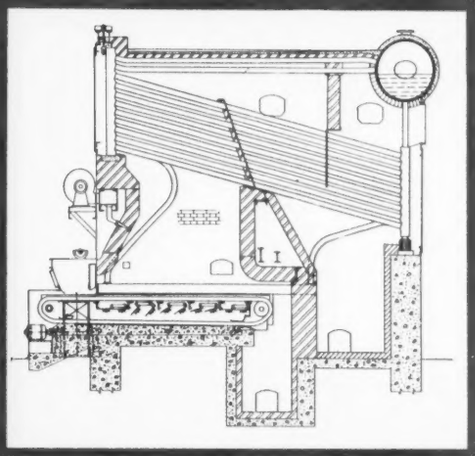


Type H Stirling Boiler

A low-head, moderate-pressure unit which has proved popular in small industrial plants, institutions, hotels, office buildings, etc. It is built in capacities ranging from 1,500 to 30,000 lb. of steam per hr. The furnace is usually of the refractory type.

B&W Design 32 Cross-Drum Boiler

This unit is widely used in small and medium-size power plants where refractory furnaces are suitable. It has the advantages of straight-tube, sectional-header construction found in B&W Cross-Drum Boilers designed for larger capacities.



& WILCOX

LIBERTY ST., NEW YORK, N. Y.

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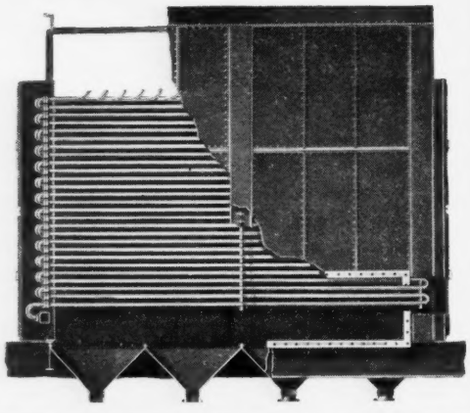
B&W Component



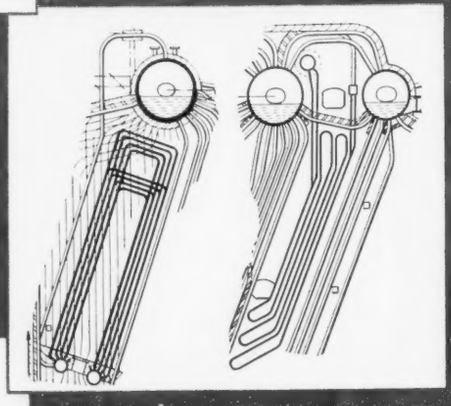
← Economizers

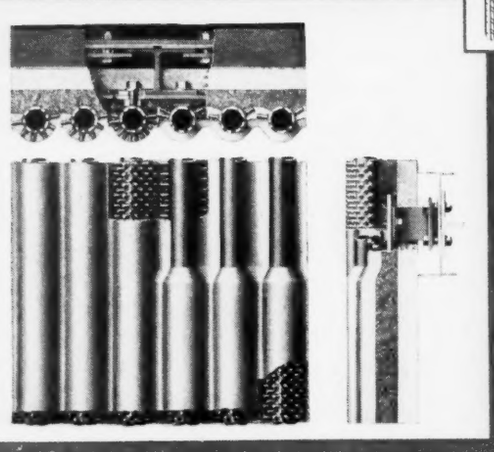
B&W Economizers are available to meet the size and pressure requirements of any installation. A Return-Bend Economizer is shown; this unit can be easily cleaned; pressure parts may be inspected while it is in service.

The Babcock & Wilcox Company builds boiler units complete with all essential components, from fuel preparation and burning equipment to breechings and stacks. The Company thus

Superheaters →

B&W Superheaters are properly designed and fabricated, with respect to steam and gas flow, so as to function efficiently with boilers designed and built by B&W. Both draining and non-draining types are illustrated.



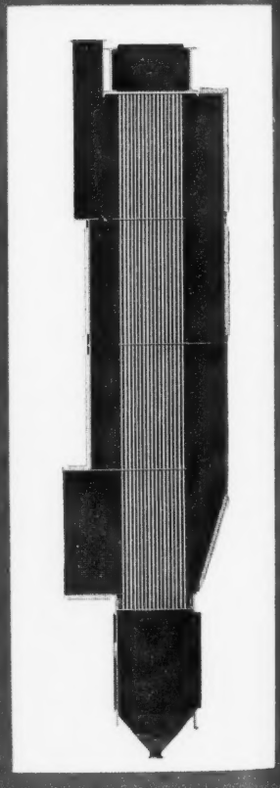


Air Heaters →

B&W Tubular Air Heaters are inherently tight and efficient, and easy to keep clean. Illustrated is a unit having longitudinal gas flow; a multi-pass, cross-flow type is also available.

← Water-Cooled Furnace Constructions

B&W Water-Cooled Furnace Constructions make possible furnaces of any size, shape or form, suitable for any fuel or combustion method in which complete or partial water cooling is desirable. Illustration shows one type of B&W Water-Cooled Furnace construction.



BABCOCK &

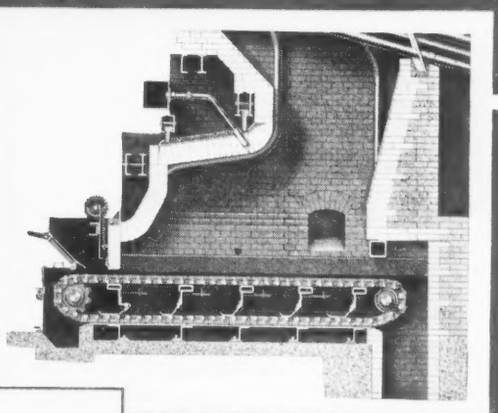
THE BABCOCK & WILCOX CO.

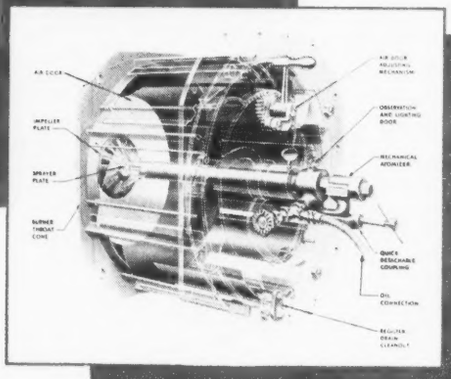
Equipment means undivided responsibility

has control over both the design and application of the equipment, and co-ordinates the various elements to provide the greatest assurance of satisfactory performance.

Chain-Grate Stokers

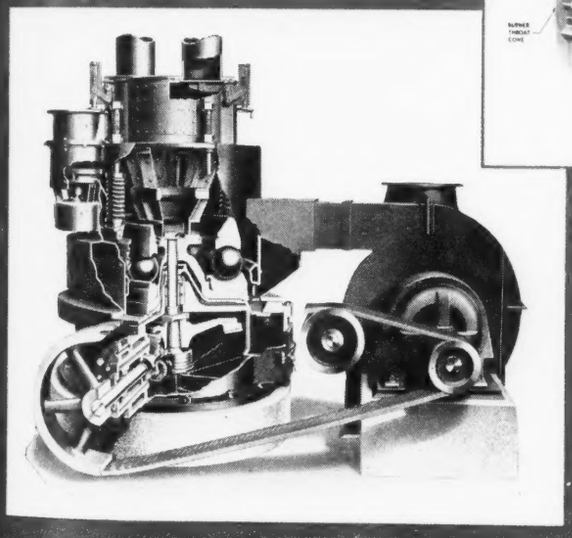
Babcock & Wilcox Chain-Grate Stokers are suitable for use with bituminous or anthracite coals, lignite or coke breeze. They are adaptable to natural, induced or forced draft, depending upon the size of stoker and the operating conditions.





Oil Burners

B&W Oil Burners are available in both mechanical and steam-atomizing types. They effect rapid and complete combustion and are preeminent in their ability to operate efficiently at both high and low capacities.



B&W Pulverizers

The ball bearing principle of grinding is employed — has been used successfully and economically in more than 700 installations. Features include high availability, consistently high fineness, low power consumption, low maintenance.

Other B&W Products

Pulverized-Coal Feeding & Burning Equipment
Driers for Coal
B&W-Tomlinson Recovery Process
B&W Refractories
Alloy Castings
Seamless Steel Tubes and Pipe
Pressure Vessels
Stacks and Breeching

& WILCOX

85 LIBERTY ST., NEW YORK, N. Y.

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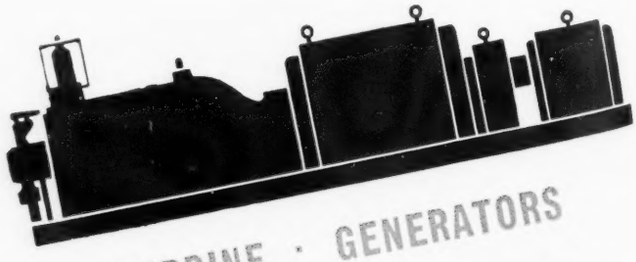
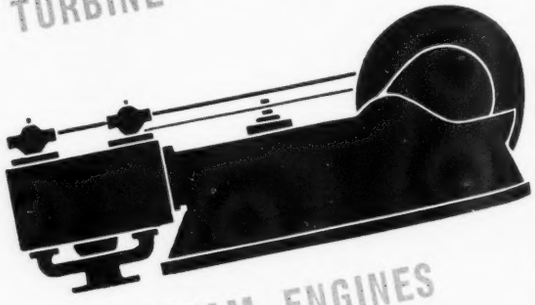
A BUYER'S GUIDE *for* ASSURED PERFORMANCE

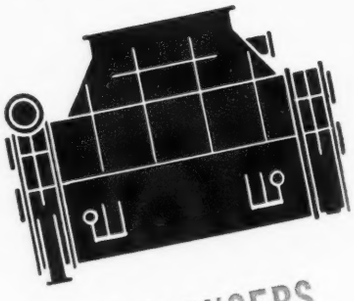
ELLI



TURBINE · GENERATORS



STEAM ENGINES



CONDENSERS

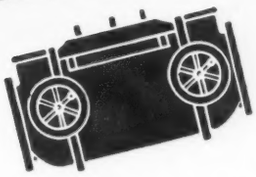
Well-built equipment—skillfully engineered to *your* requirements—followed up to see that it makes good in *your* plant. That's why you can safely depend on "Characteristically Elliott" performance. Full data in separate bulletins for the asking.

ELLIOTT COMPANY

JEANNETTE, PA. • RIDGWAY, PA. • SPRINGFIELD, OHIO

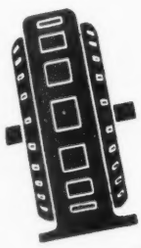
DISTRICT OFFICES IN PRINCIPAL CITIES

TUBE CLEANERS



STRAINERS

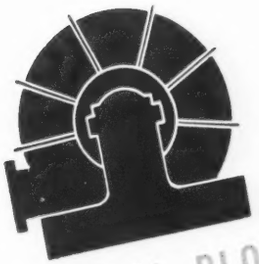
OTT



GENERATORS

MOTORS

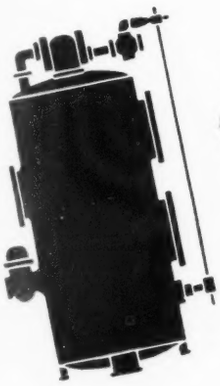
MECHANICAL DRIVE TURBINES



CENTRIFUGAL BLOWERS

TURBO-CHARGERS for DIESEL ENGINES

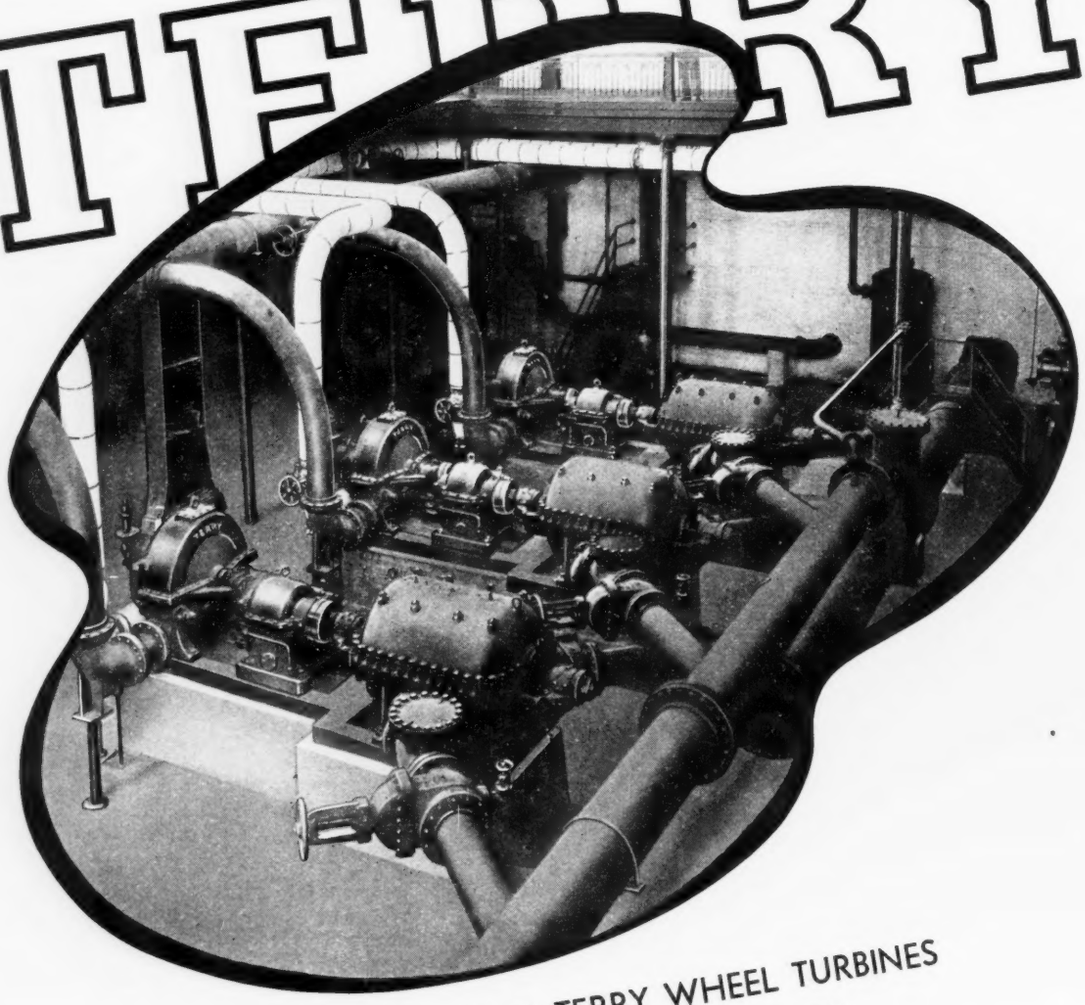
SEPARATORS



FEEDWATER HEATERS and DEAERATORS • DESUPERHEATERS • FILTERS • NON-RETURN VALVES • STEAM JET EJECTORS

Q-1079

TERRY



FOR 14 YEARS THESE 700 H. P. TERRY WHEEL TURBINES HAVE BEEN ON QUICK STARTING SERVICE

The three 700 H. P. Terry Turbines shown above are called upon to start up from a cold stand and deliver full output in less than 90 seconds—a strenuous task, with extra loads on blading, rotors, bearings and governors.

But these Terrys have been meeting every demand since their installation fourteen years ago. They have that extra ruggedness that makes for dependable operation and long life.

The rotors are the Terry one-piece steel design. The turbine buckets are milled from the solid metal. There are no parts to work loose. The blades have large clearances and are rim protected.

End play can do no damage to the blading as the side clearance is very large. There is no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

T-1120

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

ANNOUNCING—

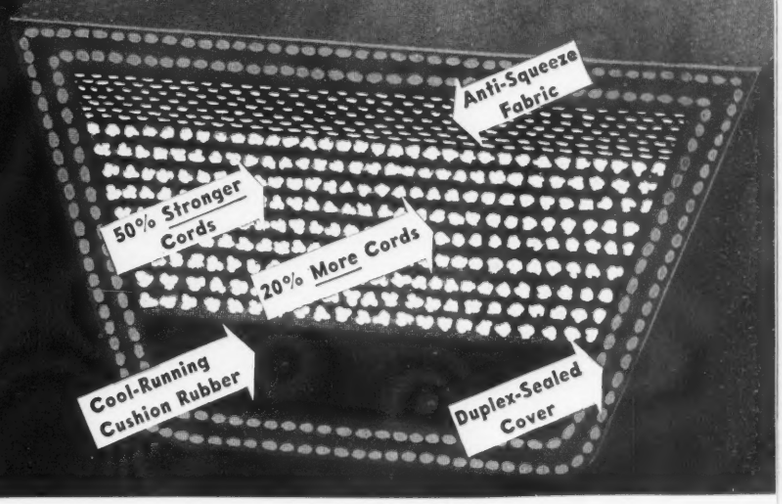
50% MORE CORD STRENGTH IN NEW TEXROPE SUPER-7!

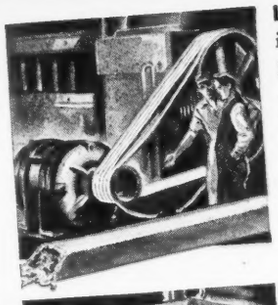
1 50% STRONGER CORDS! Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.

2 20% MORE CORDS! Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.

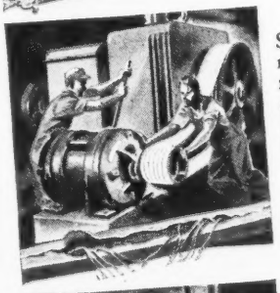
3 INCREASED LIFE! Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.

4 EXTRA PROTECTION! Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

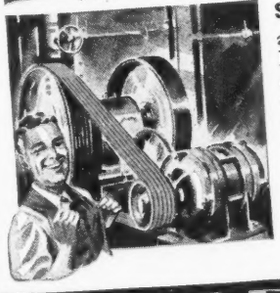




LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong . . . but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.



WARNING SIGN! Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.



SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch . . . great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.

A1435

DISCOVERED! A new way to make load-carrying V-belt cords — the Flexon process!

In this amazing new method, the cords are made smaller . . . and 50% stronger. And because they are smaller, 20% more of them are used in each belt.

That's the big news behind the new Texrope Super-7 V-belt. But that's not all the news —

For in this new belt we use a new special heat-resisting rubber compound that acts as a cushion to absorb operating shocks and dissipate internal heat. And we wrap the belt in a new "duplex-sealed" two-ply cover for extra protection against dirt, moisture, and other destructive elements.

Added up, these four-fold advantages mean you get *more pulling power . . . greater resistance to excess stretch . . . and much longer life in Super-7 than in any belt you ever heard of.*

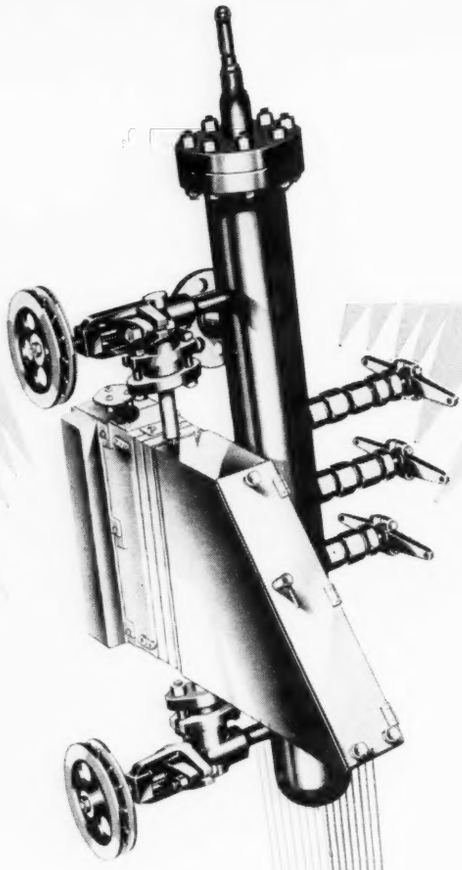
We want you to know all about Super-7 V-belts. We want you to try them. For here are belts *that are better* . . . and *they cost no more!*

For the complete story about Super-7, call the Texrope dealer near you . . . or the Allis-Chalmers district office in your neighborhood.

Available in All Sizes —
½ hp to 2000 hp.

*Trade mark registered U. S. Patent Office. Texrope Super-7 Belts are the result of the cooperative research and design genius of *two* great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by Allis-Chalmers.

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN



RED
IS STEAM

AN EMPTY GLASS
IS ENTIRELY
RED

GREEN
IS WATER

A FULL GLASS
IS ENTIRELY
GREEN

Over 1000 DIAMOND BI-COLOR WATER GAUGES

Water Always Shows Green
Steam Always Shows Red

More than 1000 Diamond Bi-Color Water Gauges have been placed in service. The Bi-Color Gauge makes boiler water level reading *sure*, no matter how inaccessible the gauge may be.

Ready and rapid acceptance of these Gauges is an index of the value they offer to the engineers of large plants.

By a simple, invariable optical principle, the Diamond Bi-Color Water Gauge always shows the water as green—always shows the steam as red. The dividing line between the two colors is the water level. This line follows water level changes instantly . . . with no lag at all.

Operators do not have to determine water level by unaided sight. They do not have to depend upon reports at intervals from water tenders in a high gallery. They do not strain to read a gauge high over head. Reading is so clear it can be mirrored to operating level from a high drum through as many as three platforms of grating without the slightest confusion. The image may be made a part of the control panel—right under the operator's eye.

Write for Bulletin No. 917-A.

DIAMOND POWER SPECIALTY CORP.

Detroit, Michigan

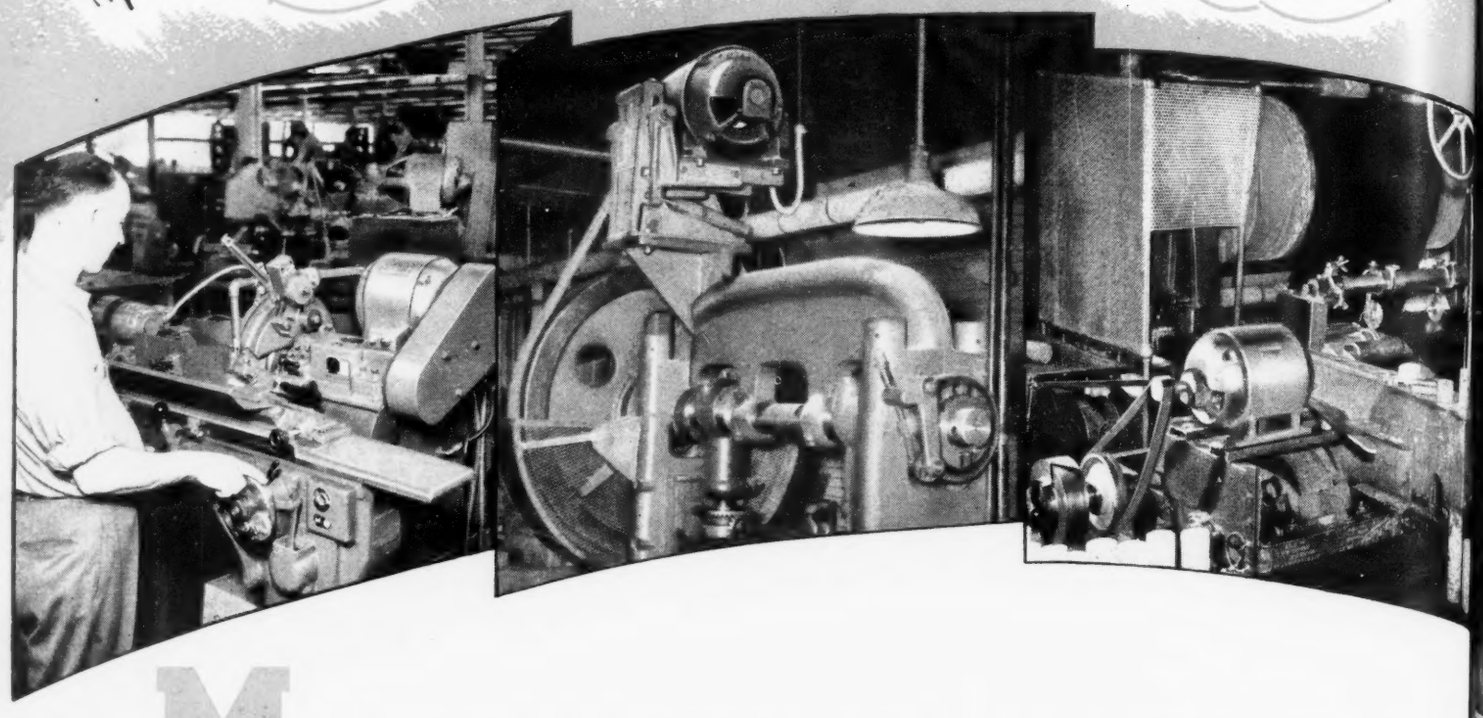
DIAMOND SPECIALTY LTD. • Windsor, Ontario

NOW YOU'RE TELLING US . . .

The cast-iron frame appeals to metal workers—it fends off filings, chips, and accidental blows.

Operating men like the way it stands up under loads in hot surroundings near the ceiling.

The dampness of wet-processing operations doesn't faze this motor. In standard or splashproof types, it's an excellent drive for such applications.



Motor users are proving the case

FOR TRIPLE PROTECTION.....MODERN DESIGN

ACTIONS speak louder than words. In the short time that they have been available, Tri-Clad motors have won a host of friends in a wide variety of industries because of the way they stand up under trying operating conditions. More significant, however, than the extent of their use are the applications in which Tri-Clad motors are seeing "front-line" service. Here are a few tough spots in which they are proving their mettle:

On equipment which must operate in hot or damp surroundings, or where the motor is subjected to flying chips or falling objects—*extra protection against physical damage* keeps these motors going in spite of this unavoidable abuse.

On equipment responsible for vital defense production—*extra protection against electrical breakdown* helps to assure continuity of operation 'round the clock.

On equipment which must perform month in and month out without babying by the maintenance crew—*extra protection against operating wear and tear* prolongs the years of smooth, quiet service.

On equipment which is expected to *look attractive* by virtue of smoothly contoured modern design, the functional styling of the Tri-Clad fits in perfectly.

Why not give Tri-Clad motors a chance to show you just what continuous, economical motor operation is? Next time you order a motor or a motor-equipped machine, specify Tri-Clad. *General Electric Company, Schenectady, N. Y.*

GENERAL ELECTRIC

750-92-8

....WHY TRI/CLAD IS TOPS

REG. U.S. PAT. OFF.

Plant men find Tri-Clad motors easy to maintain. Lubrication features facilitate quick oiling or greasing. Smooth contours can be readily cleaned.

Tri-Clad motors are a cinch to install. Electricians like them because of the roomy conduit box and the permanently identified terminals.

Machine builders and buyers both like the way that these motors blend in with the neat, attractive appearance of modern machines.

GENERAL ELECTRIC

TRI/CLAD

MOTOR

Tri-Clad induction motors are now being produced in 16 fundamental electrical types and 8 basic mechanical constructions. Call your local G-E motor representative for information on availability of types and sizes to meet your needs.

BUILT FOR PROTECTION FIRST...TO LAST!

AMERICAN ENGINEERING

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Hele-Shaw Fluid Power, Lo-Hed

ARE YOU IN THE "A-E-CO AREA"?

The "A-E-CO Area" includes all steam producers ranging from 12,000 to over 400,000 pounds of steam per hour. ALL types of steam plants are embraced in this A-E-CO Area—industrials, heating plants, central stations, municipals and institutions.

The A-E-CO Area represents that range of operations to which today's Taylor Stoker delivers a BALANCE of advantages which cannot be duplicated by other fuel firing equipment.

Generalizations must be scrapped in an emergency. This Nation is in an emergency of production. AND, men like yourself control productive capacity. Faced with the responsibility of making specific recommendations concerning fuel firing equipment, you must be more than ever fully informed on ALL types and ALL makes.

It would be foolish to say that any type or any make of equipment is the most suitable for all conditions of operation. Each operation, *your* operation, has specific requirements which can be met best by only one type or one make.

Taylor Stokers fit certain situations, meet certain conditions of operation more advantageously than any other type or make of fuel firing equipment. It is also true that they cannot be applied as advantageously to ALL installations.

But, IF YOU ARE IN THIS A-E-CO AREA, it is probable that Taylor Stokers will give you the most practical balance of the 12 factors required for economical, unhampered steam production in a manner which cannot be duplicated by any other equipment.

Where do you stand? In the A-E-CO Area? Then it is of utmost importance that you carefully and conscientiously investigate Taylor Stokers. It is important for you to "look at the record". It is important to get (and compare) ALL THE FACTS. Only then can you be certain your recommendation for equipment is fully substantiated from every consideration.

SEND FOR FREE BULLETINS—giving facts on each of the 12 factors influencing economical, continuous steam generation. Indicates the "balance of power" requirements for your own plant. Write American Engineering Co., 2400 Aramingo Ave., Phila, Pa.

Use These 12 Factors as a "Check Chart" in Demanding FACTS About Any Fuel Firing Equipment

RELIABILITY The Taylor Stoker has a 35 year record of reliability of which 92.7% is typical.

CAPACITY Emergency reserve capacity is readily available over long periods of operation.

MAINTENANCE Average is 3.4c per ton based on a recent study of a typical group of plants.

FLEXIBILITY From 40,000 to 300,000 lbs/hr in 72 seconds. Cold boiler, no fire, to 250% rating in 20 minutes.

EFFICIENCY 16.73c for fuel per thousand pounds of steam is indication of A-E-CO Taylor Stoker "dollar" efficiency.

OPERATION Simplest of any. No complicated adjustments. Coal direct from mine to hopper.

ADAPTABILITY Modernization can be accomplished without seriously disturbing existing plant structure.

FUEL FLEXIBILITY Handles coals of widely varying characteristics; detailed list on request.

REFUSE DISPOSAL Choice of 3 methods; power dump, continuous and rotary.

STACK DISCHARGE 90% average of ash to ash pit. Dust-recovery equipment rarely used—even in heart of city locations.

SPACE REQUIREMENTS Conforms to short and wide, or long and narrow furnaces.

OBSOLESCENSE One basic design used for 35 years enables new improvements to be added to numerous existing installations.

THE A-E-CO Taylor Stoker

COMPANY

AE CO

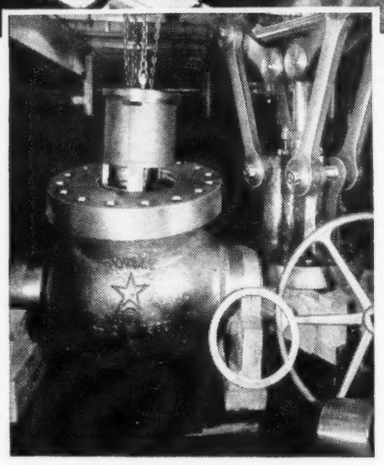
Hoists, Marine Deck Auxiliaries

TWO STEPS AHEAD OF PLANES AND TANKS...

Before planes, tanks, guns and ships come the machines to make them. And to drive the machines Industry needs Power. The capacity to produce that power was not created overnight.

For years the makers and users of power equipment had been quietly searching for ways to boost production of power. New methods were studied . . . different metals were tested. And the years of research bore fruit. From 1920 to 1938 steam pressures were increased four times. New boilers ten times as powerful as 1920 models were built. Today, aided as in peacetime tasks by INCO Nickel Alloys, they are assuring an uninterrupted flow of the driving force essential to all-out production.

The unexcelled performance of Monel*, "S" Monel*, "K" Monel* and the other INCO Nickel Alloys as vital parts of Power Plant equipment has been demonstrated for years. Today, the need for these metals is more pressing than ever.



12-inch toggle-operated non-return valve with welding ends for 1500 lbs. W.S.P. at 900° F., as manufactured by Wm. Powell Co., Cincinnati. The cylindrical guide for disc, and the disc itself shown in foreground are made of cast "S" Monel heat-treated to 320-350 Brinell.

• • •

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.

INCO NICKEL ALLOYS

MONEL ★ "K" MONEL ★ "S" MONEL ★ "R" MONEL
"KR" MONEL ★ INCONEL ★ NICKEL ★ "Z" NICKEL

SHEET . . . STRIP ROD . . . TUBING . . . WIRE . . . CASTINGS

*"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

Can You Drown a Motor?

HOW MUCH punishment should a motor be able to take? This is an important question to motor buyers . . . for you never know when you'll need *extra* performance . . .

Take the case of the Western Molybdenum Corporation mine at Chewelah, Washington. They bought an Allis-Chalmers Pump powered by an Allis-Chalmers 10-hp Lo-Maintenance Motor.

Motor and pump were placed on a raft in a well. But due to an obstruction in the shaft, the floats stuck, and the motor operated under water for four days before it was noticed.

Then, to top it off—because the motor switch was still on when the water was lowered, the current ran through the exposed motor for 15 minutes more!

But—in spite of this terrific punishment, all that was needed was 24 hours of oven drying. Then the motor was hooked up... the switch turned on . . . and it purred into instant action. There was no additional repair cost . . . and today this motor is still giving 100% service!

For Lower Maintenance!

An exceptional case, certainly. In fact, we don't claim that Lo-Maintenance Motors are built for under-water operation. Nor will you probably ever demand this type of service. But it is your right to demand motors that cost a minimum of maintenance under *all normal operating conditions!*

That's the kind of low-cost, dependable performance Allis-Chalmers Lo-Maintenance Motors give you.

RUNNING FOUR DAYS UNDER water didn't stop a 10-hp Lo-Maintenance Motor located in a well pit of the Chewelah, Wash., mine of the Western Molybdenum Corporation.

It's performance based on full-measure, no-stint construction, distortionless stator, indestructible rotor, high carbon steel frame, and other extra-value engineering features.

Get the facts from the trained engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin.

A1392

ALLIS-CHALMERS LO-MAINTENANCE MOTORS

A COMPLETE LINE FOR EVERY PURPOSE...ONE-HALF HORSEPOWER AND UP

One Belt

CAN LIVE AS CHEAPLY AS *Four!*

A WESTERN match block manufacturer had so much stretch trouble on his gang saw – he kept four belts constantly on hand, interchanging them whenever take-up was necessary. Heavy loads, high speed and small pulleys combined to make belt life short, hazardous and expensive.

At length, the G.T.M.–Goodyear Technical Man – was asked to suggest a remedy. He specified Goodyear COMPASS "40," truly endless, and the most nearly stretchless belt made.

That was in July, 1938. Since then, over a period of nearly three years, this belt has given flawless service. There has been no stretch, no interruption for repairs. Even now it looks good enough for some time to come.

Seems hard to believe, but even the initial cost of the COMPASS was 1/3 less than that of the belts used previously. Less hard to believe is the fact that this plant has purchased nothing but COMPASS belts ever since!

Why not ask the G.T.M. to point out to you the patented COMPASS features that help run up records like this on industry's toughest drives? To bring him to your office, write: Goodyear, Akron, Ohio or Los Angeles, California – or phone the nearest Goodyear Mechanical Rubber Goods Distributor.

THE GREATEST NAME IN RUBBER

GOODYEAR

Compass–T.M. The Goodyear Tire & Rubber Company

Linde Customers

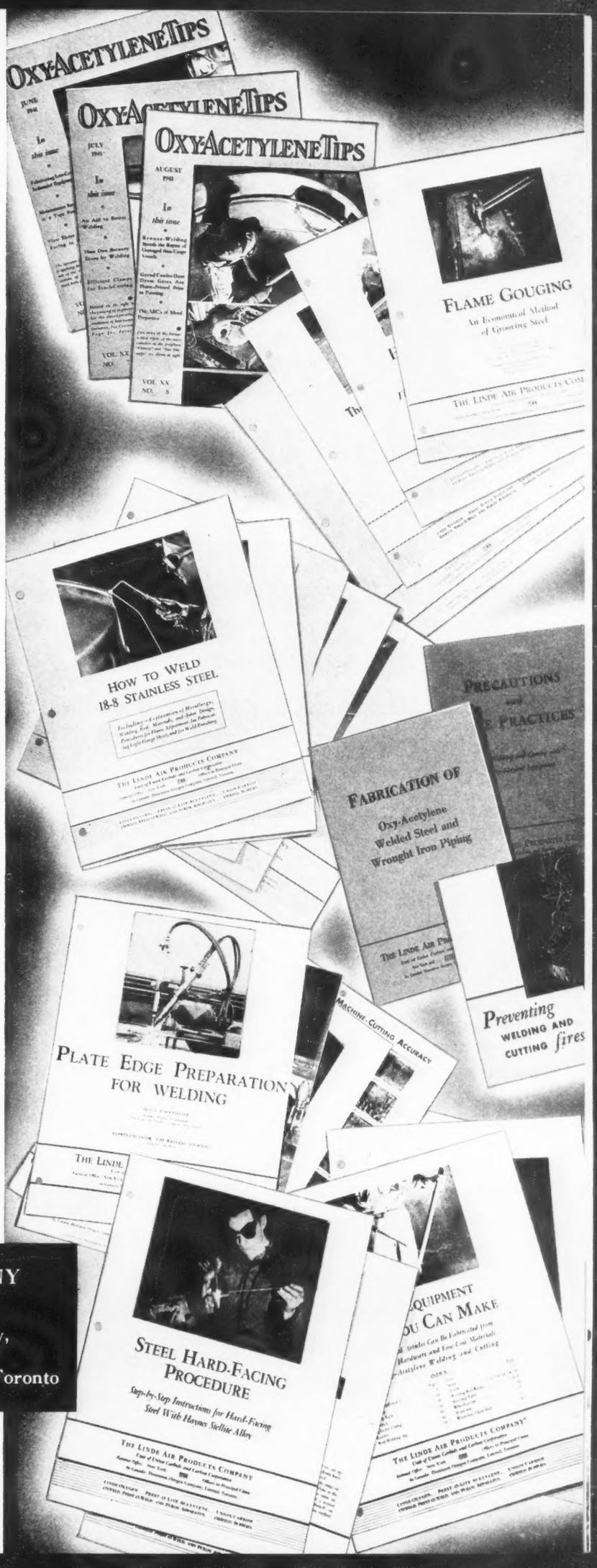
Draw On This Large Library Of Oxy-Acetylene Process Information

THE Linde organization has made available a large library of oxy-acetylene process information on which customers can draw freely. The material in this Linde Library is designed not only to add to the knowledge of welding and cutting operators, but also to suggest to designers, engineers, and production men many ways in which Linde methods can be used to do better or quicker production work where the use of metals is involved. In addition, much of this literature is provided to suggest means of lowering the costs of maintenance work.

The Library consists of handbooks, instruction outlines, reprints of engineering articles, design data, safety folders and even a monthly "how-to-do-it" periodical, OXY-ACETYLENE TIPS. Among the many subjects covered are: oxy-acetylene welding, flame-hardening, flame-priming, flame-gouging, shape-cutting, stack-cutting, and hard-facing.

If you want to know more about how Linde helps its customers use Linde oxygen, Prest-O-Lite acetylene, and Union Carbide effectively—get in touch with Linde today.

The words "Linde," "Prest-O-Lite," and "Union," are trade-marks of Units of Union Carbide and Carbon Corporation.



THE LINDE AIR PRODUCTS COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
New York, Chicago, Birmingham, Kansas City,
San Francisco, and other Principal Cities
In Canada: Dominion Oxygen Company, Limited, Toronto

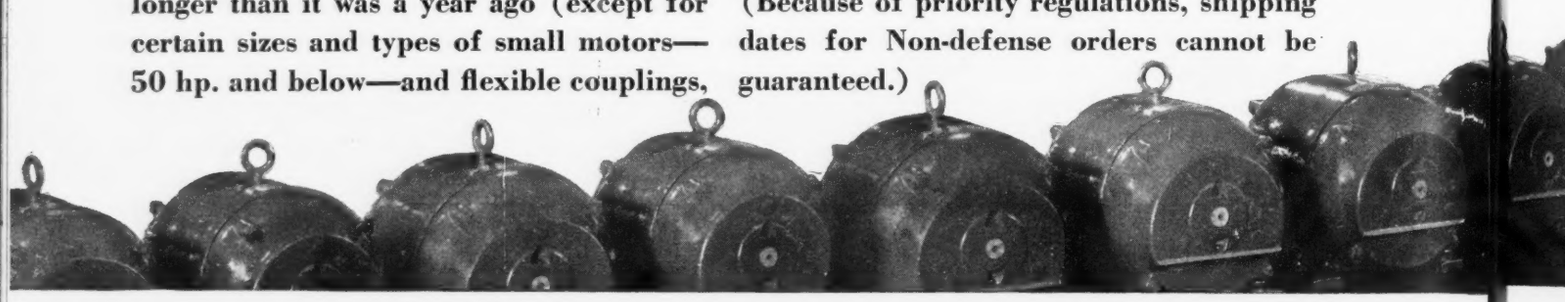
We are still

FOR MOTORS, GENERATORS, M/G SETS

While it is true that the Crocker-Wheeler plant is working day and night . . . . that our backlog is greater than at any time in the history of the Company . . . . that 90% of our output is for National Defense—*there is still some room at the end of our production line for more orders for our regular products.*

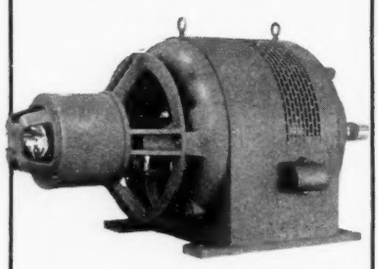
Naturally, the time required for shipment of these products is considerably longer than it was a year ago (except for certain sizes and types of small motors—50 hp. and below—and flexible couplings, some of which are still carried in stock in our Ampere and Chicago warehouses).

The principal products of the Company are pictured below, together with a summary of the capacities in which they are built. If you are having trouble obtaining motors or generators or flexible couplings, perhaps we can help you. For price and delivery, write, wire or phone to the Crocker-Wheeler district office nearest to you. (Because of priority regulations, shipping dates for Non-defense orders cannot be guaranteed.)



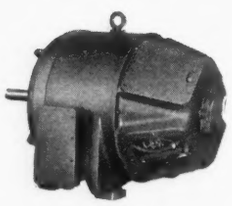
POLYPHASE INDUCTION MOTORS

¼ to 10,000 hp.—Squirrel-cage and slip-ring, for all standard ratings, speeds, voltages and frequencies—single and multispeed—open and enclosed. Squirrel-cage motors with normal or high starting torques, normal or low starting currents.



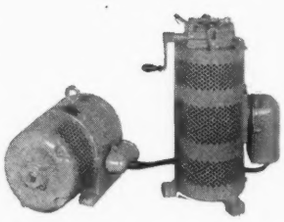
SYNCHRONOUS MOTORS

15 to 10,000 hp.—Engine-type and coupled-type for all standard ratings, speeds, voltages and frequencies. Motors with excess capacity for power-factor improvement are available.



DIRECT-CURRENT MOTORS

½ to 5,000 hp.—All standard ratings—constant, varying and adjustable speed—open and enclosed. Adjustable-speed motors for constant-horsepower, tapered-horsepower or constant-torque duty, for speed ranges up to 6:1.



POLYSPEED MOTORS

1 to 7½ hp.—Adjustable-speed motors for operation on alternating current—220, 440 or 550 volts, 3 phase, 60 cycle. Motors provide an infinite number of speeds.

FREE BOOKLET—CARE AND OPERATION OF INDUCTION MOTORS

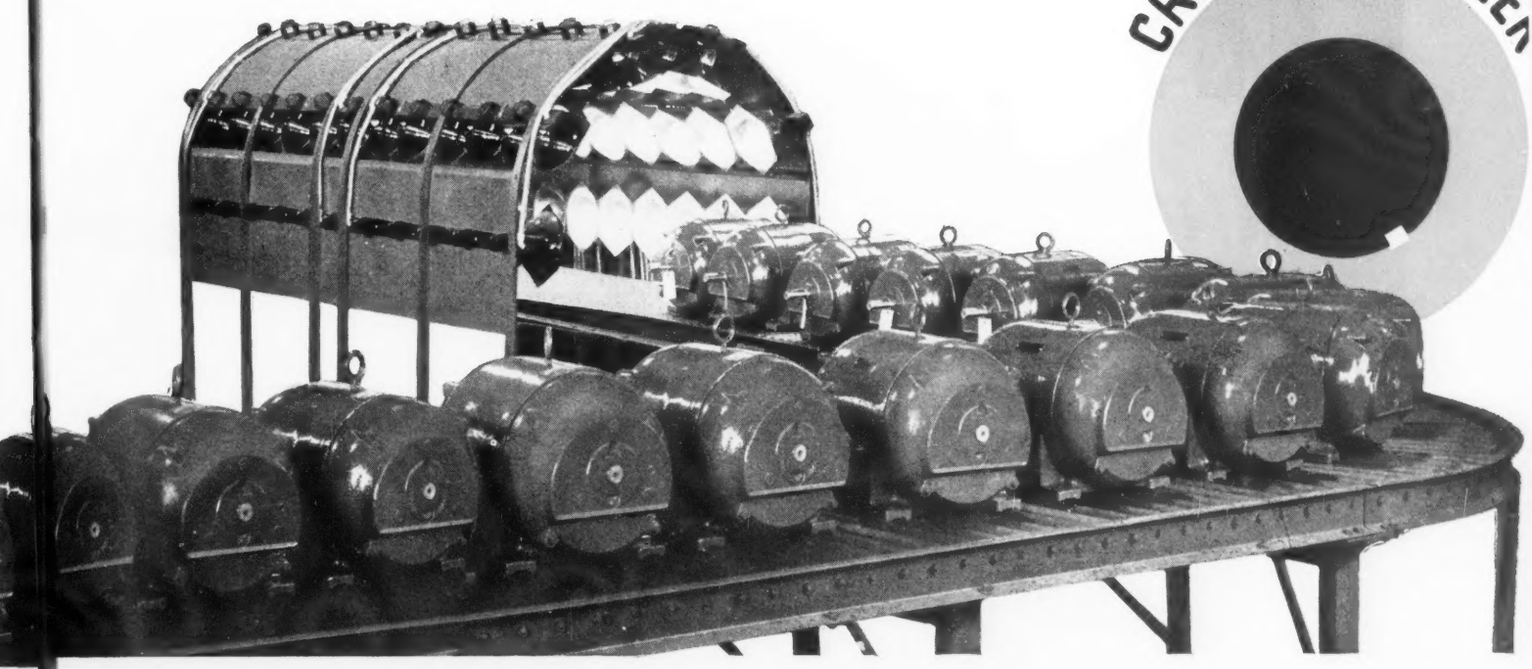
Today, when motors are hard to get, and production must be kept moving at top speed, it is more important than ever before that you have no motor failures in your plant.

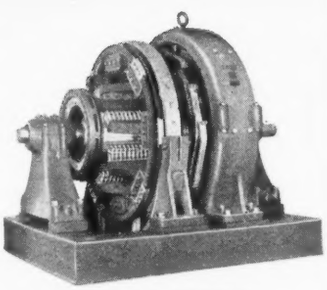
This little 12-page booklet gives helpful hints for keeping your induction motors on the job. Contents include: *Effects of Voltage Variation, Lubrication of Bearings, Drying-out, Cleaning, Heating, Troubles, etc.*

Write today, on your company letterhead, for your copy of *Instruction Book No. 501*. No charge—no obligation.

accepting orders...

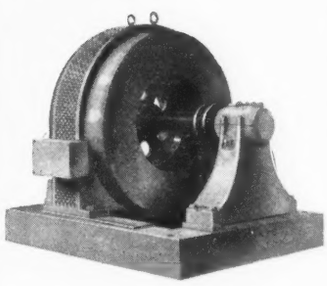
AND FLEXIBLE COUPLINGS





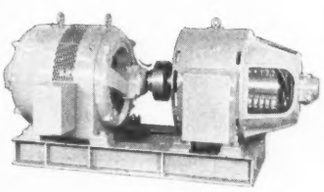
DIRECT-CURRENT GENERATORS

Up to 7,500 kw.—Belted, coupled and engine types for standard and special voltages. Three-wire generators with self-contained auxiliary windings in sizes above 40 kw.



ALTERNATING-CURRENT GENERATORS

Up to 10,000 kva.—Belted, coupled and engine types for use with steam, gas or oil engines—25 to 60 cycles—standard voltages to 13,200 volts.



MOTOR-GENERATOR SETS

Up to 7,500 kw.—With either an alternating-current motor (induction or synchronous) or a direct-current motor driving an alternating-current or direct-current generator.

COUPLINGS

For shaft diameters up to 5 inches—C-W flexible couplings were designed to provide maximum torsional resilience. They require no lubrication, possess great shock absorbing qualities, are easily installed and have an extremely long life.

CROCKER-WHEELER

CROCKER-WHEELER ELECTRIC MANUFACTURING COMPANY • AMPERE, N. J.

DISTRICT SALES OFFICES

Boston, Mass.	Cincinnati, Ohio	Newark, N. J.	Pittsburgh, Pa.
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In Canada: Commonwealth Electric Corporation, Limited, Welland, Ontario

GREEN

MECHANICAL DRAFT
AIR PREHEATERS
ECONOMIZERS
CINDERTRAPS

for that needed increase in capacity . . . and with a return up to 100% on your investment

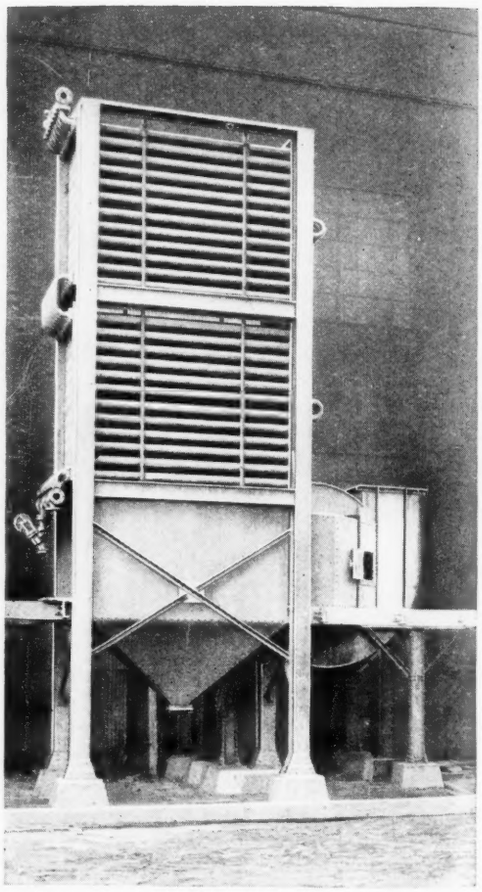
IF YOUR power plant dates back to the early twenties—if you are not using modern heat recovery equipment—if you are pushing that plant sixteen, eighteen, twenty-four hours a day in the "all out" for national defense, we can save thousands of dollars for you—yearly.

For example, substantial savings can be made through the installation of a Green Fuel Economizer. When you remember that there is a one percent direct fuel saving for every ten degrees rise in feed water temperature, you should see the dollars-and-cents value of such an installation.

The total savings effected often exceed the first cost of this equipment the first year—and then pay a generous dividend throughout years of service. Why not consult Green—now?

The
GREEN FUEL ECONOMIZER COMPANY, Inc.
Beacon, New York

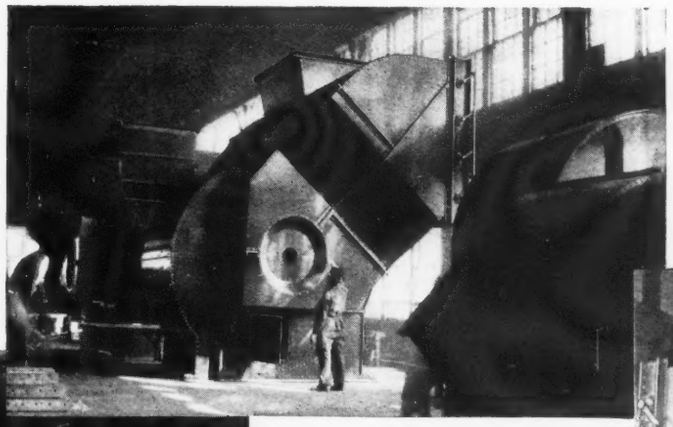
Write for complete information



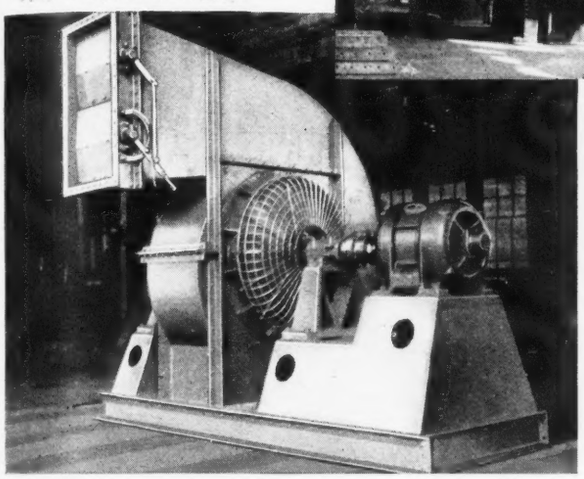
FUEL ECONOMIZERS

Cast iron and steel having many advantages proven by years of service. Cast iron types built for pressures up to 450 lbs. per sq. in. and steel tube extended surface type to 1625 lbs. per sq. in.

12 GF-2

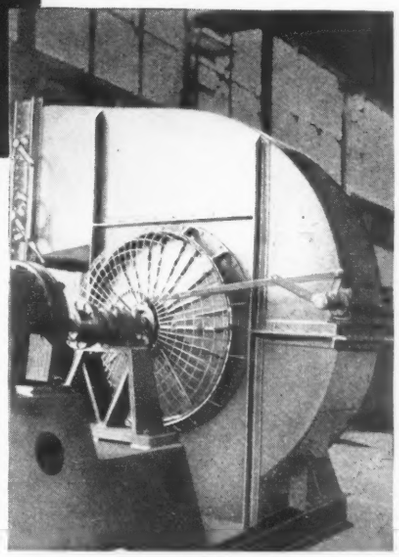


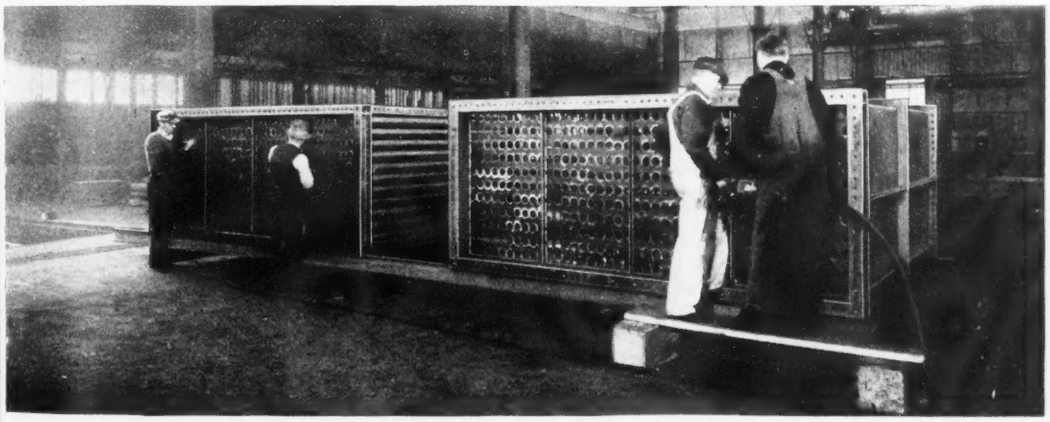
INDUCED DRAFT FANS
For mechanical draft service. All speeds. Especially designed to retard abrasion from cinders and dust.



FORCED DRAFT FANS
Custom built for every mechanical draft service. All types of volume control. For heavy duty service. Efficient, dependable, economical.

INLET VANE CONTROL
For varying fan capacity with constant speed motor drive of sturdy design for heavy duty service.



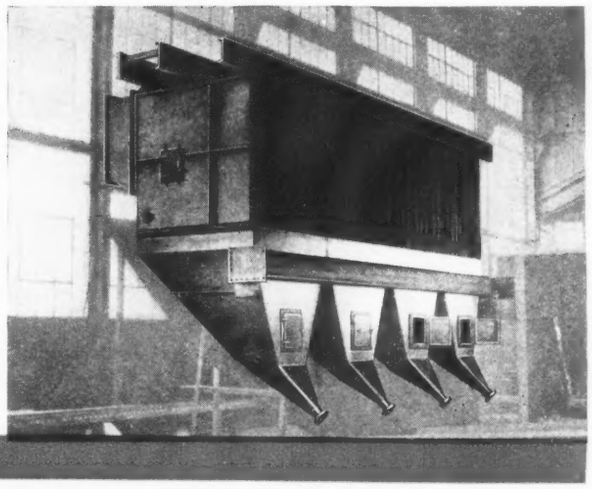


AIR PREHEATERS
Tubular and plate types of cast iron or steel. Waste heat recovery with minimum maintenance. Many in service with gas temperatures to 2300°.

CINDERTRAPS
For stoker fired boilers. Good recovery—low draft loss (0.1" to 0.2"). Tested in accordance with the latest A.S.M.E. Tentative Code.

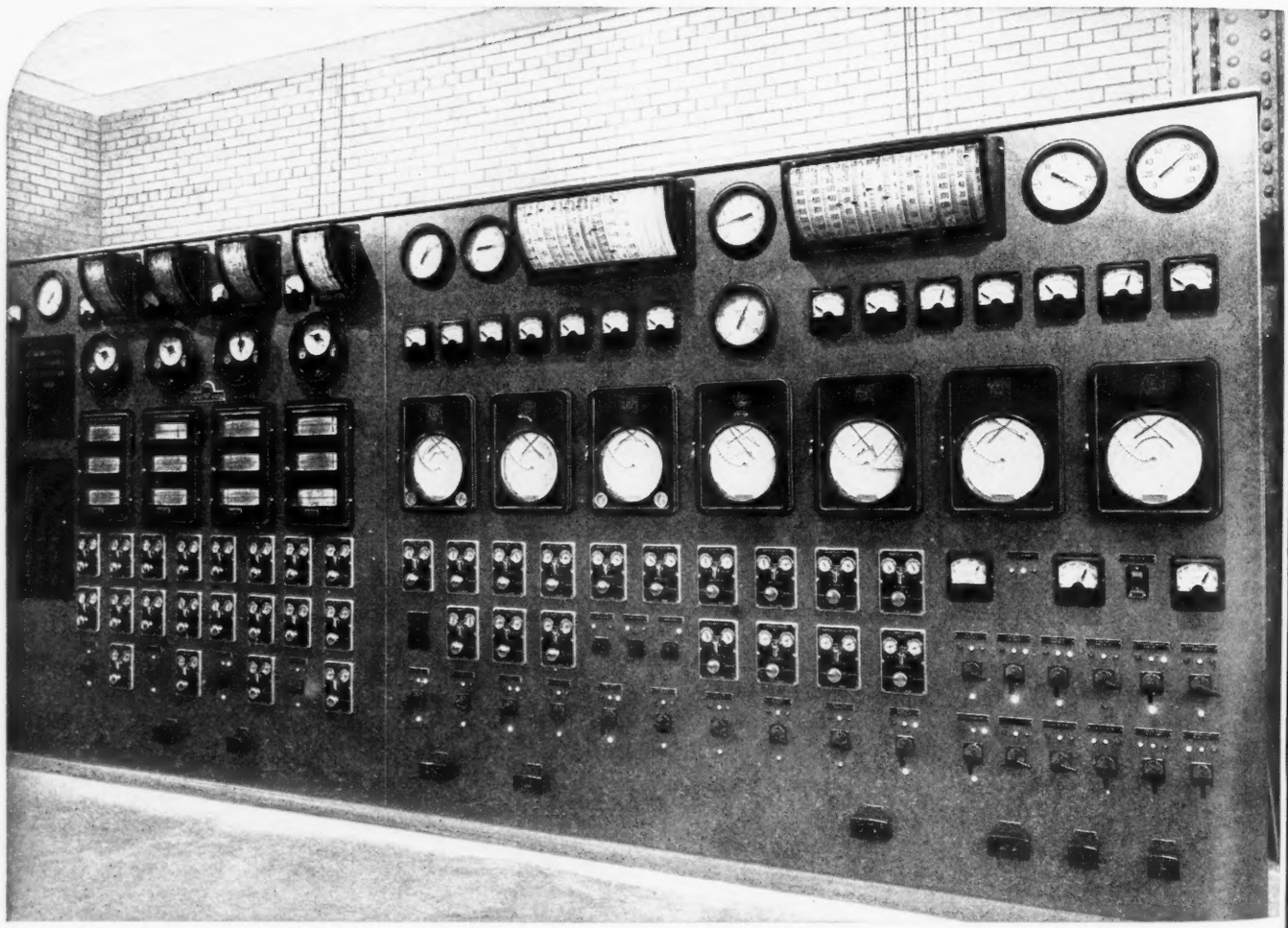
THE
GREEN
Fuel Economizer
COMPANY
INC.

BEACON NEW YORK



"ALL-OUT" Aid to the BATTLE OF

Bailey Meter Control Insures with Conservation of Fuel



Bailey Boiler Control Panel for Combustion and Three-element Feed Water Control Systems serving a 900,000 lb. per hour capacity boiler at the Oswego Station of Central New York Power Corporation

BAILEY METER CONTROL...

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

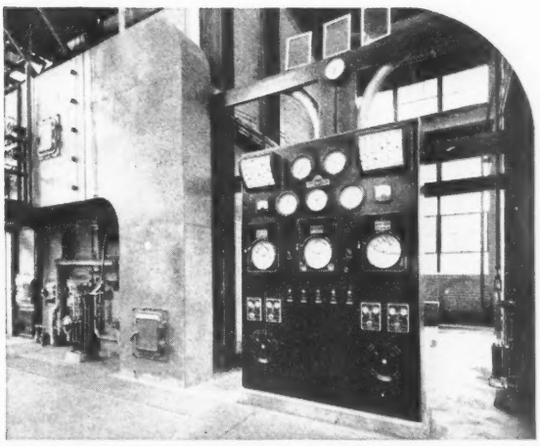
Boilers in PRODUCTION

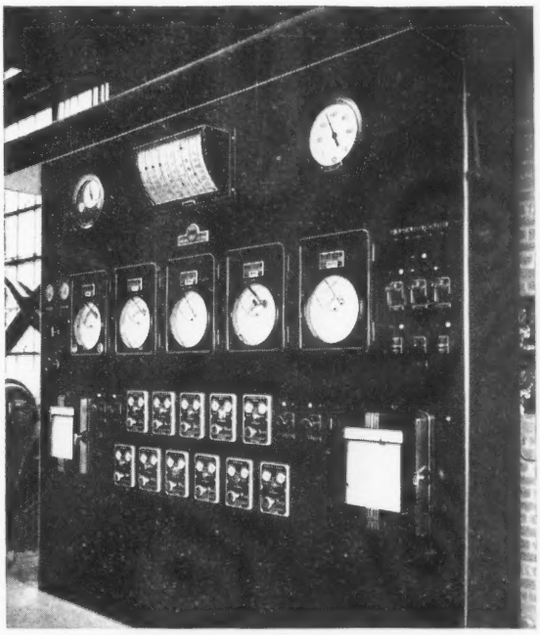
Full Steaming Capacity and Man Power ★ ★ ★

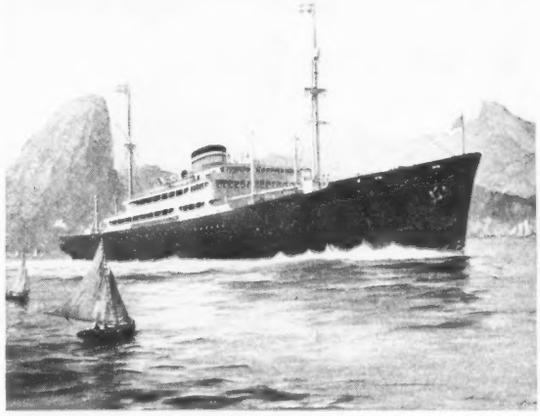
★ Bailey Meter Control is helping to win the battle of production by giving "All-Out" aid to hard pressed steam generating equipment. Here at the very source of power, Bailey Meter Control serves faithfully day after day to continuously maintain the most favorable operating conditions. Conditions which mean full capacity, reliable service, safe operation, economical use of fuel, and conservation of man power.

In addition to serving in the battle of production, Bailey Meter Control is "with the colors" at Air bases, Army training camps, Naval bases, Arsenals, Forts, and other establishments of our armed services. It is also serving at sea with America's fast-growing Merchant Marine.

Bailey Meters and Control are now helping to speed National Defense by the same fundamental methods of boiler control which in the past have made available generous supplies of low cost steam power. A-77





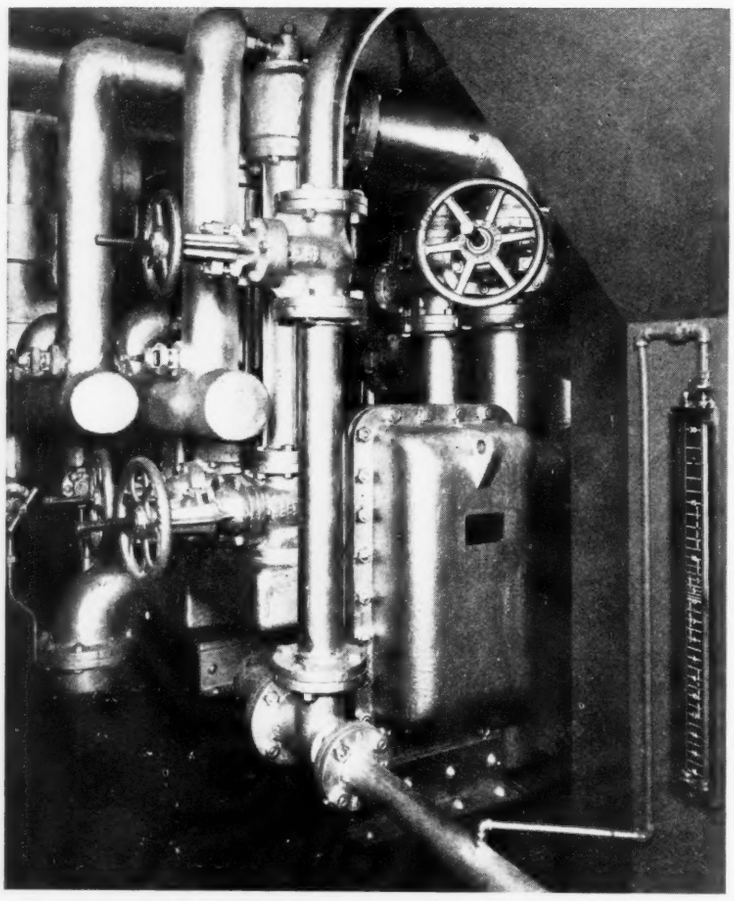


Bailey Meter Control is installed in many industries vital to our defense. Three of these are—(Top) A Plastic and Chemical Plant, (Center) A large Steel Plant, and (Bottom) The Merchant Marine.

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL



Two-stage main steam jet air ejector for power plant turbine condenser. Two first stage jets are in front of two secondary ones. Inter and after condensers are combined in the common shell. Air discharge line is shown at the lower right with air flow manometer.

STEAM JET AIR EJECTORS

Steam jet air ejectors are furnished for any condition of service where gases or vapors are to be evacuated at low pressures. Great increases in efficiency have been developed in the last five years.

Single-stage, two-stage, three-stage and four-stage ejectors are available. In general, the single-stage ejector is suitable for a vacuum up to 26.5 inches of mercury. The two-stage ejector is used for vacua of 26.5 to 29.3 inches, the three-stage for vacua of 29.3 to 29.9 inches, the four-stage for vacua to 29.98 inches.

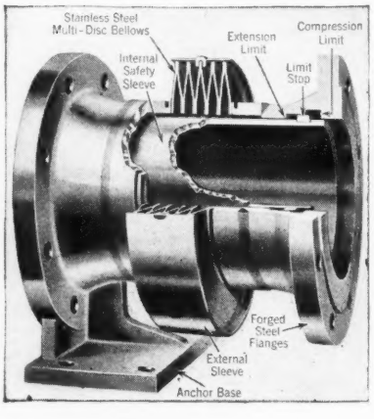
Isolating valves are provided with multi-stage units at the discharge of primary elements and at the suction and discharge of secondary elements. These cut off all communication either to main or inter condensers; any element of the ejector may then be opened or removed completely, if necessary, for inspection or repair.

TYPE 'S' EXPANSION JOINTS

The new type 'S' all-welded bellows expansion joint has been developed to meet the wide operating range of present-day power and heating plants.

The flexible element consists of a low carbon, stainless steel, multi-disc bellows built to the most exacting specifications. The bellows is constructed by an exclusive welding process which leaves unaltered the stainless and physical characteristics of the steel discs.

Standard pressure series are 50 lb., 150 lb., and 300 lb.; standard sizes 2 to 36". A 600 lb. series is available upon request. Normal working temperature for these joints is 750° F., but with special modifications they may be furnished for 1000° F.



FOSTER WHEELER CORPORATION, 165 Broadway, New York, N. Y.

FOSTER WHEELER

Specify "SPLIT-GLAND" Columns for Your Next Project

. . Most Important of the Boiler Attachments is the Water Gage

Gages can be set at any angle or vertical
ALIGNMENT & STIFFENER ROD
Water Level Visible From Below
ERNST WATER COLUMN & GAGE CO. LIVINGSTON N.J. U.S.A.

FIG. 1 illustrates "Split-Gland" Inclined High and Low Alarm Column for steam working pressures up to 300 lb.

★Ernst improved DUO-COLOR Illuminator gives a bright RED reflection of the water level in the glass without any special Red-Line gage glass. Can be seen on boiler room floor with aid of Mirror Stand.

NO GAGE GLASS PACKING NUTS

ADVANTAGES INCLUDE:

Simple and Easy to install a Gage Glass FLAT, ROUND or REFLEX TYPE. No wrenches or tools required to do this.

Unobstructed clear view of the water level.

Gage Glasses can be set at any desired angle, or vertical.

Upper and Lower Valves are interchangeable, therefore—Gage Glasses can be set to the right or left of valve bodies.

"Straight through" passageways facilitate cleaning.

No Valves or "Dirt Traps" between Shut-off Valves and Column.

Adjustable for perfect alignment of Gage Glasses, hence no breakage due to misalignment.

Extra deep Packing Spaces insure against leakage.

The "off-set" feature also provides for illumination directly from rear of glasses if desirable.

Made for pressures up to 2000 lbs.

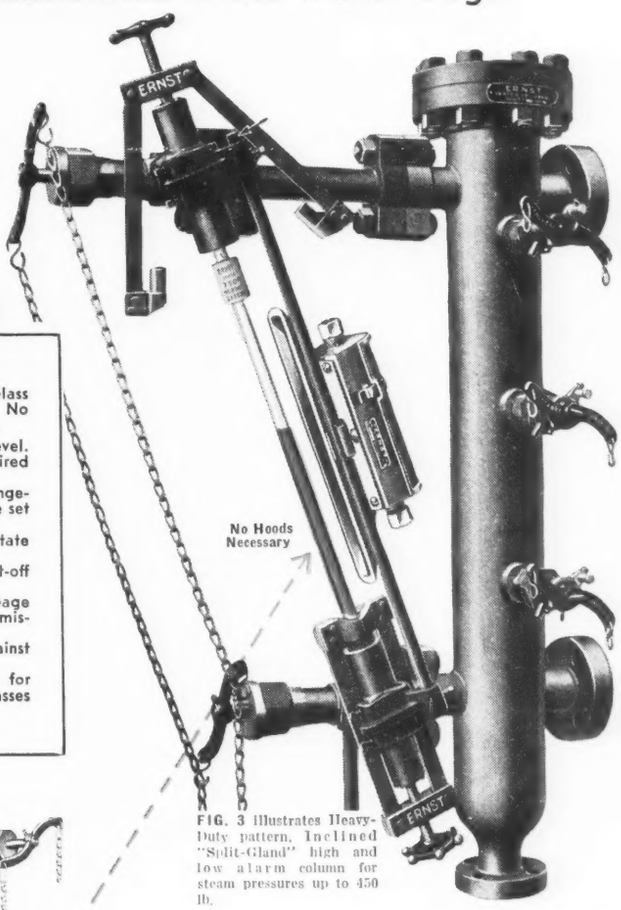


FIG. 3 illustrates Heavy-Duty pattern, Inclined "Split-Gland" high and low alarm column for steam pressures up to 450 lb.

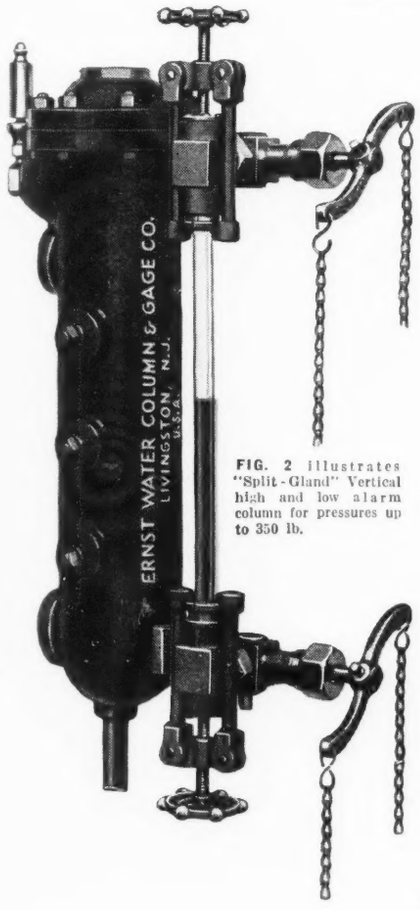


FIG. 2 illustrates "Split-Gland" Vertical high and low alarm column for pressures up to 350 lb.

FIG. 72 illustrates "Split-Gland" Column with "C-Clear Thru" Flat Glass Insert, for working pressures ranging up to 1500 lb.

FIG. M2

COMPLETE

Water Column Equipment

How to specify

Each Boiler to be furnished with Ernst Split-Gland Water Columns suitable for — pounds working pressure. Equipment consisting of Column, Split-Gland Adjustable Water Gage Fittings and Leakless Super Try Cocks. Gage Glass Guards and Illuminators are to be furnished, and sufficient rust-proof Chain to operate Gages and Try Cocks from boiler room floor.

All material as manufactured by Ernst Water Column & Gage Co. Livingston, N. J.

OTHER ERNST SPECIALTIES

Water Columns, Forged Steel
High and Low Alarm Columns
Bronze Vertical Water Gages
Forged Steel Water Gages
All Iron Gages
"C-Black" Reflex Inserts
"C-Clear Thru" Flat Glass Inserts
Leakless Super Try Cocks
Spring Type Try Cocks
DCP Weighted Type Try Cocks
Forged Steel "Leakless" Try Cocks
Round-Tubular gage glasses, clear or red-line type
Clear and Reflex glasses with gaskets
Series 750, Composition gage glass gaskets
Illuminators, Plain Sight

Send for Catalog No. 45 Describing the above

ERNST WATER COLUMN & GAGE COMPANY

LIVINGSTON, N. J.

Representatives in Principal Cities

See our ad in A.S.M.E. 1942 Directory, Page 96

TIME *is impor*

tant to National Defense

Conserve it with

LUNKENHEIMER

VALVES

ESTABLISHED 1862

THE LUNKENHEIMER CO.

"QUALITY"

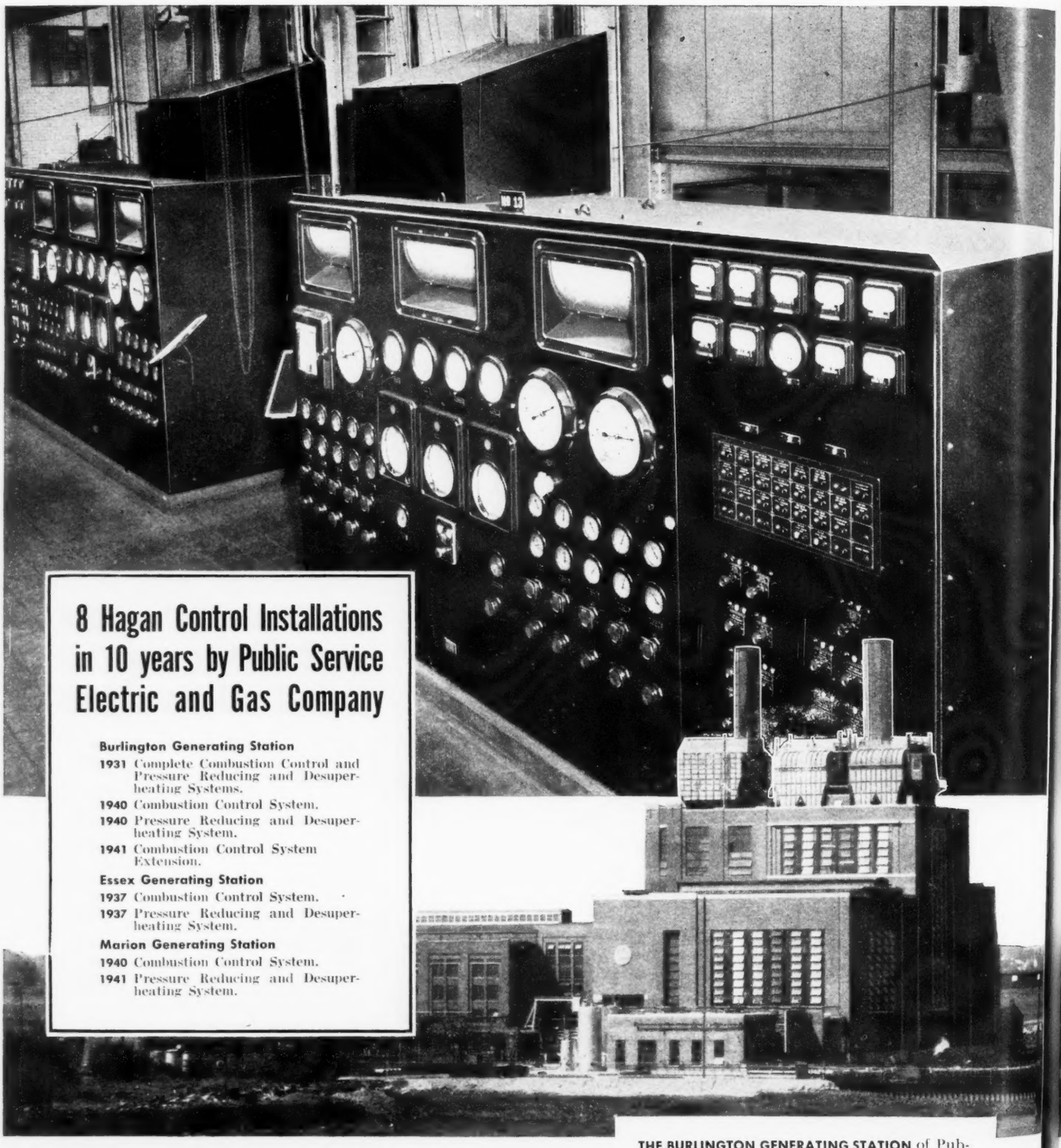
CINCINNATI, OHIO. U. S. A.

NEW YORK CHICAGO
BOSTON PHILADELPHIA

EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

28-88-42

Public Service Electric and Gas Company



8 Hagan Control Installations in 10 years by Public Service Electric and Gas Company

Burlington Generating Station

1931 Complete Combustion Control and Pressure Reducing and Desuperheating Systems.

1940 Combustion Control System.

1940 Pressure Reducing and Desuperheating System.

1941 Combustion Control System Extension.

Essex Generating Station

1937 Combustion Control System.

1937 Pressure Reducing and Desuperheating System.

Marion Generating Station

1940 Combustion Control System.

1941 Pressure Reducing and Desuperheating System.

THE BURLINGTON GENERATING STATION of Public Service Electric and Gas Company, New Jersey. Three Hagan Automatic Combustion Control installations have been made in Burlington Generating Station since 1931. These systems control boilers operating at 650 and 1350 pounds per square inch pressure.

No matter what the type, any boiler can be equipped advantageously with Hagan Control.

REORDERS HAGAN CONTROL SEVEN TIMES IN FOUR YEARS

New high efficiencies obtained by enlarged Burlington, Essex and Marion Generating Stations

PUBLIC Service Electric and Gas Company, Newark, N. J., has enlarged three of its five generating stations since 1937, installing new units in Burlington, Essex and Marion Generating Stations.

Because of the splendid results and reliable performance obtained with an original installation of Hagan Automatic Combustion Control in the Burlington Generating Station in 1931, *fully automatic* Hagan equipment was ordered for all three stations when the new additions were made.

When increasing power demands necessitated further expansion, Hagan Control was reordered to establish *fully automatic,* complete control in each station.

Despite this rapid and extensive growth, power was generated *when, where* and *as* needed, without interruptions, at new *high efficiencies.*

Combustion control is not entirely responsible for increased efficiency, but consider the matter on a reorder basis. Certainly *one* measure of excellence in a combustion control system is its *reorder* record among important users. In this case, *one* good job led not to another, but to *seven* additional jobs.

Similar records are common with Hagan Automatic Combustion Control. Reorders are built into *every* job. Every installation is designed to fit the *particular* job required, to *do* the job right, automatically, and to *keep* doing it right for years.

When planning an extension or a new control installation, it is wise to look first at the leader, for a *genuine* measure of value. It is even wiser to stop right there, for Hagan Control will cost less and give you greater satisfaction in the long run—and that is what counts.

Advantages of HAGAN AUTOMATIC COMBUSTION CONTROL

INCREASED EFFICIENCY through correct proportioning of fuel and air.

CONSTANT STEAM PRESSURE.

EVEN DISTRIBUTION OF LOAD among boilers, or division as desired.

MAXIMUM STEAM OUTPUT per pound of coal.

MAXIMUM EFFICIENCY with minimum supervision.

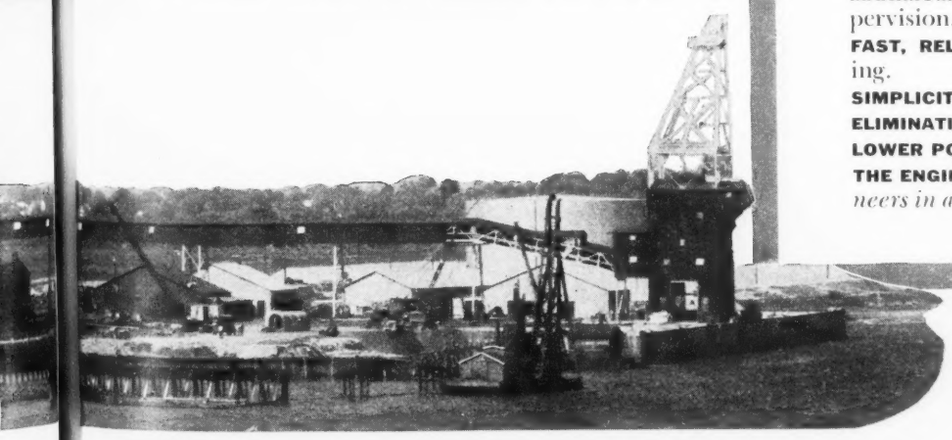
FAST, RELIABLE OPERATION without hunting.

SIMPLICITY and ease of installation.

ELIMINATION OF SMOKE.

LOWER POWER COSTS.

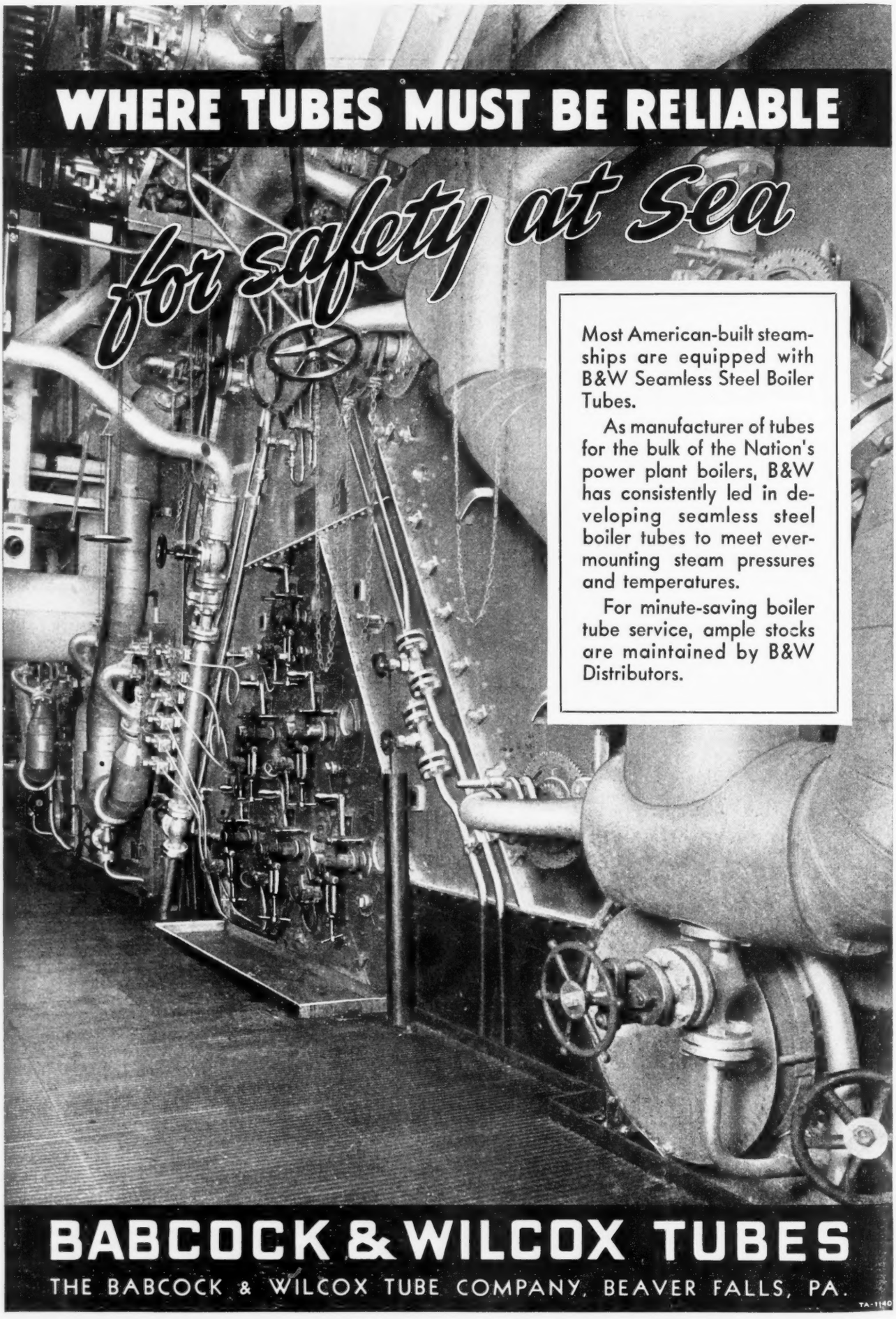
THE ENGINEERING EXPERIENCE *of the pioneers in automatic combustion control.*



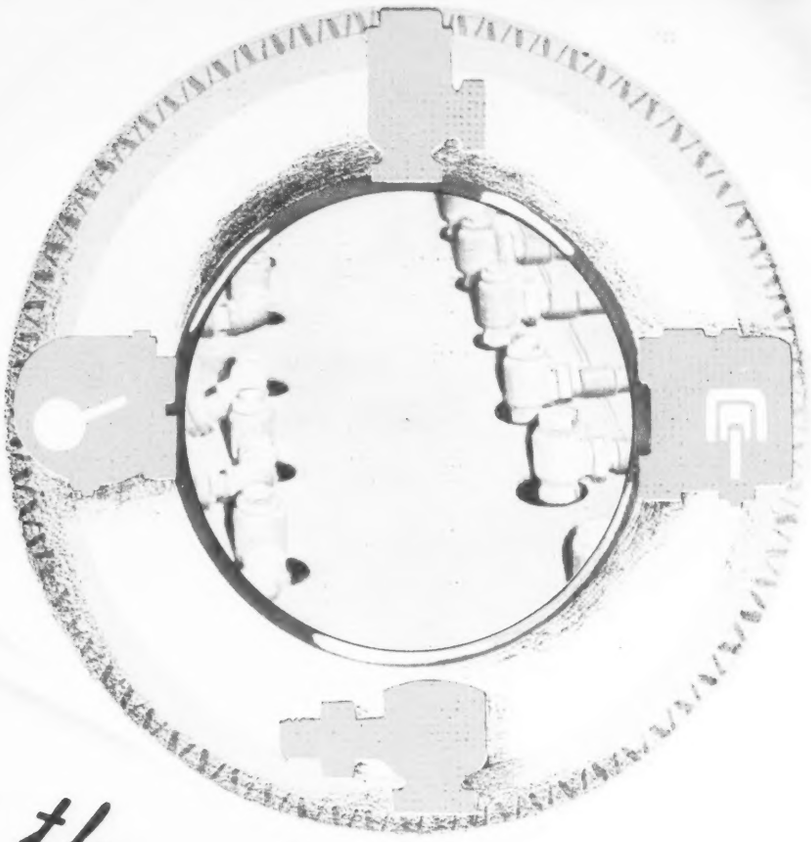
HAGAN CORPORATION • 300 ROSS STREET • PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader


WHERE TUBES MUST BE RELIABLE
for safety at Sea
Most American-built steamships are equipped with B&W Seamless Steel Boiler Tubes.
As manufacturer of tubes for the bulk of the Nation's power plant boilers, B&W has consistently led in developing seamless steel boiler tubes to meet ever-mounting steam pressures and temperatures.
For minute-saving boiler tube service, ample stocks are maintained by B&W Distributors.
BABCOCK & WILCOX TUBES
THE BABCOCK & WILCOX TUBE COMPANY, BEAVER FALLS, PA.
TA-1140

SARCO saves steam



and makes the wheels go 'round

Sarco Thermostatic Steam Trap

"Trouble-free service for years" says the engineer of this auto wheel company.

And the Sarco Steam Traps on this vento stack in the pickling room have to work every minute of the 24 hours or there would be trouble, right away. The men would be driven out of the room by acid fumes if the Sarcos failed.

At other points Sarco Radiator Traps and Float and Bucket Traps have demonstrated equal trouble-free service on various heating hook-ups and unit heaters.

The engineer of this plant says, "Always use Sarco and you will have no trouble after the installation is completed." That's an idea in these busy times.

Why not try one or two at those troublesome points in your plant? Our nearest representative will gladly show you how to select and install.

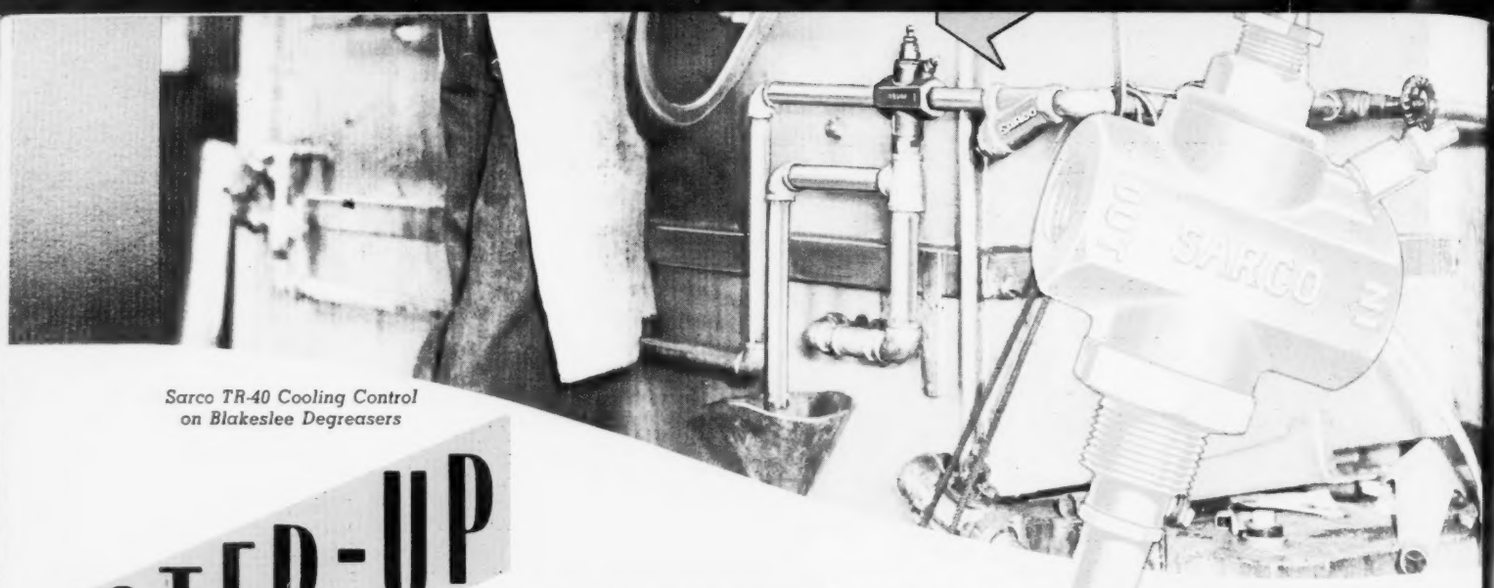
SARCO

Sarco Company, Inc.
475 Fifth Ave., New York

Represented in Principal Cities

Speeding Plastics Production

SARCO No. 9 IN PLASTICS PLANT CHICAGO



Sarco TR-40 Cooling Control on Blakeslee Degreasers

STEP-UP DEGREASER AND PLATING OUTPUT WITH SARCO CONTROLS

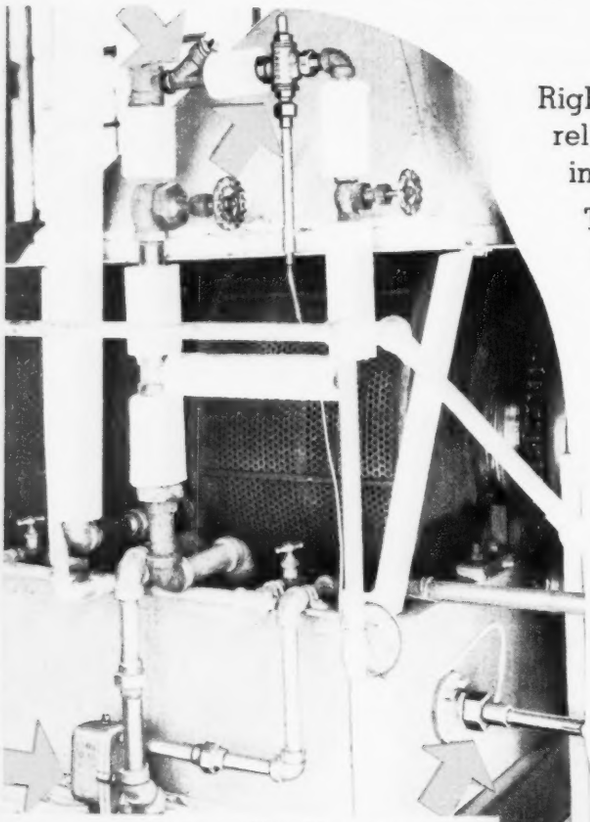
It's dependable temperature control that's needed on a modern degreaser or a plating tank. A temperature drop will slow up the whole plant—increase the number of rejects—even stop the job entirely. Too hot, the ingredients may boil over, causing excessive solvent loss, thus increasing the costs.

You can put your production on a machine-like basis with Sarco Steam Traps and Temperature Controls. The Sarco TR-40 Cooling Control shown above is already found on the original degreaser equipment of the leading manufacturers. The TR-21 Temperature Control shown below is installed by many of the largest platers.

HOOK UP WITH SARCO FOR SAFETY AND SERVICE

Right in your plant there may be a dozen spots where an even, reliable temperature could increase your rate of production, improve your product or cut your costs.

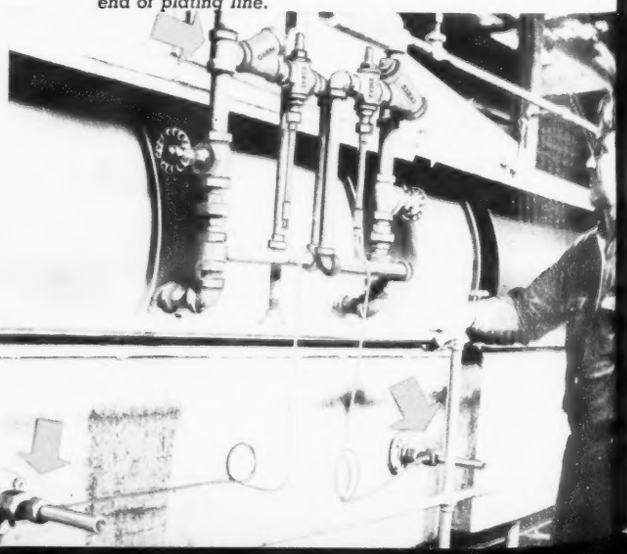
The Sarco line of controls, developed over a period of many years' service to industry, now includes items in a size and price that will suit even your smallest equipment.



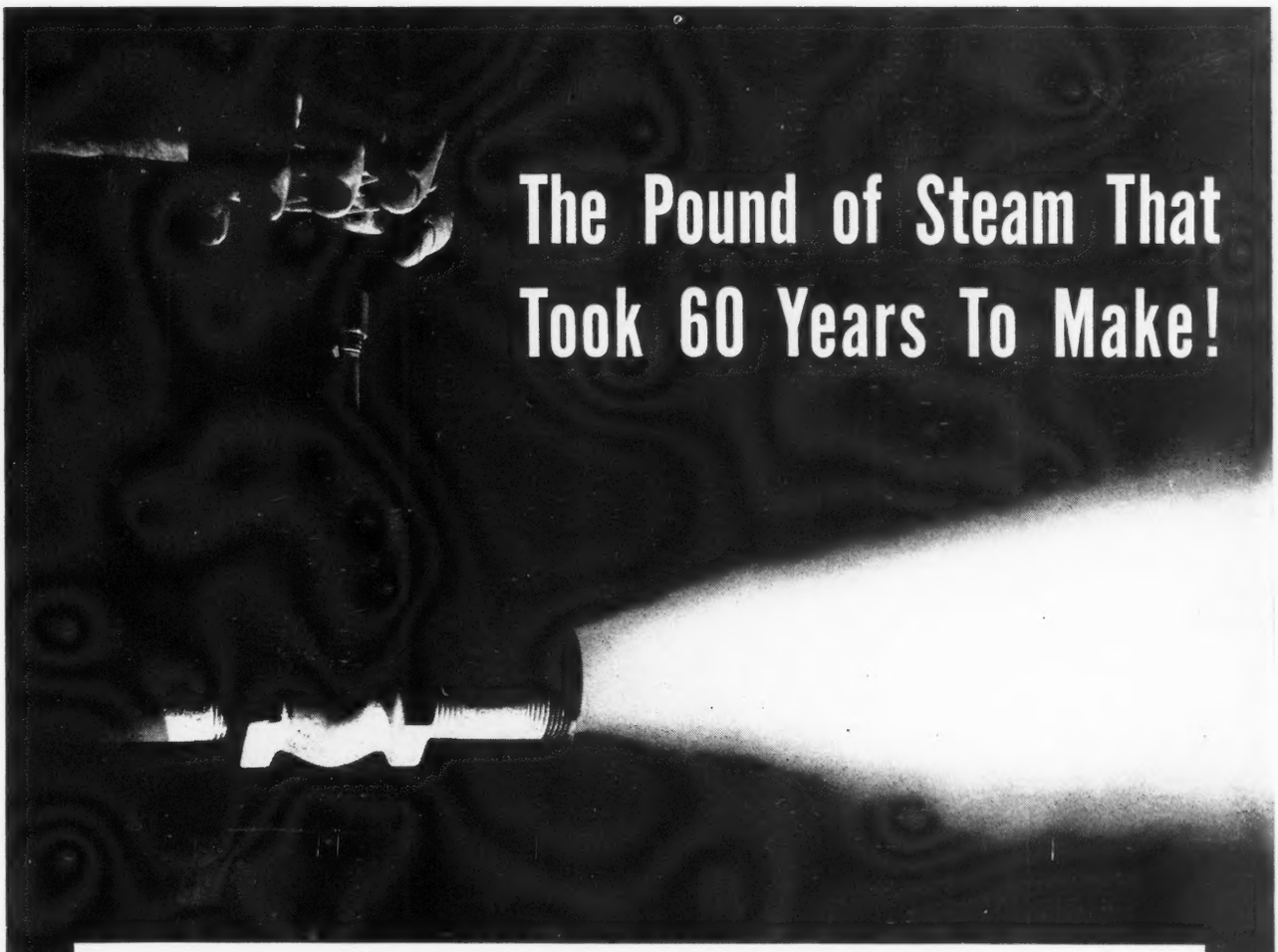
Sarco Float-Thermostatic and Bucket Traps and Temperature Regulator on end of plating line.

The Sarco TR-21 Temperature Regulator is distinguished by the fact that it is of the liquid expansion type with packless seals (no stuffing boxes).

Sarco TR-21 Temperature Regulator on alkali tanks at head end of plating line.



Sarco Company, Inc., 475 Fifth Ave., New York, N. Y.
Sarco Canada, Ltd., Toronto, Ont.
Representatives in Principal Cities



The Pound of Steam That Took 60 Years To Make!

FRANKLY— as one of the world's largest manufacturers of power plant equipment for over 60 years, we have long known the full and vital importance of correct feedwater in getting clean steam . . .

That's why — Allis-Chalmers has developed its own feedwater treatment service that *really* protects boilers and prime movers against scale, corrosion, carryover, and other feedwater ills.

From "turbines to test tubes" seems a big step. And though it took 60 years to develop this service, the value of clean steam today in keeping power plants at top efficiency is unquestioned.

IMPORTANT TO KNOW— Here's a feedwater treatment service that's based on Allis-Chalmers' inside knowledge and 60 years of experience in building power plant equipment. It's an *in-your-plant* service . . . and not to be confused with chemical-selling systems. Each plant to us is an individual case, to be solved by a trained feedwater expert backed by Allis-Chalmers' resources.

Power, today, is number one need. Don't leave your power plant unprotected against feedwater troubles. Don't risk unscheduled outages. Ask for Bulletin B6133 for the full story about the Allis-Chalmers Feedwater Treatment Service.

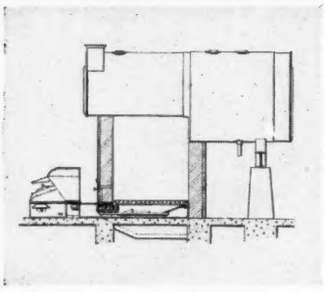
A-1449

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

WHAT "INDUSTRY"

FOR CAPACITIES FROM 1,000 TO 1,000,000 LB OF

C-E PREMIER BOILER

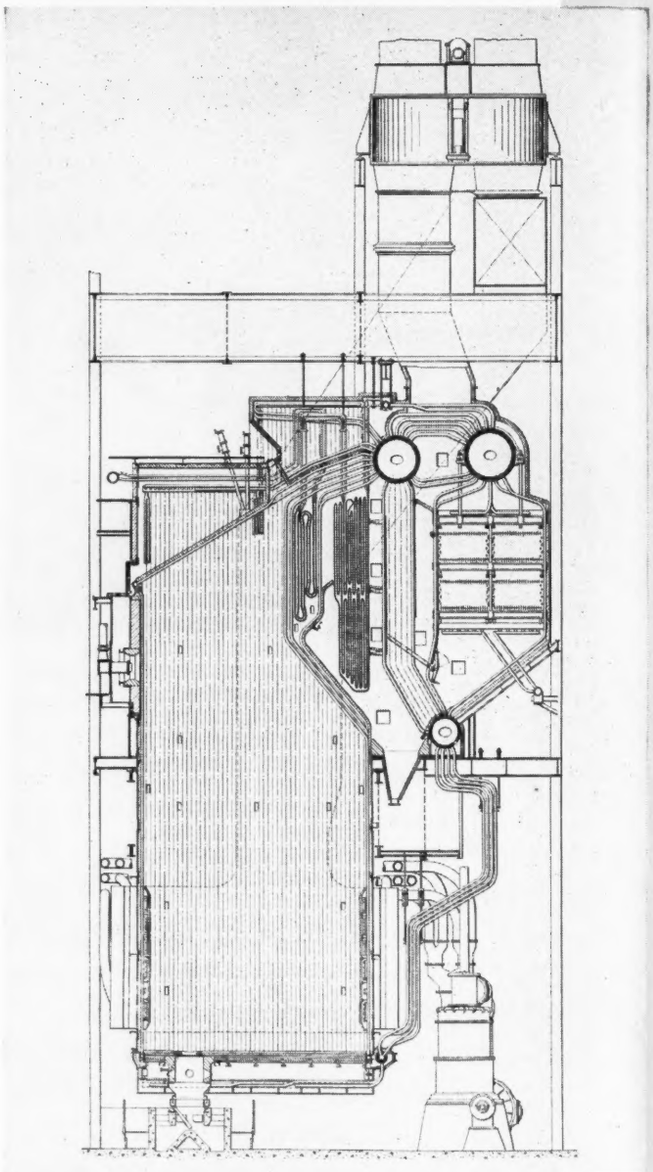


C-E SKEIDL STOKER

THIS group of actual installations, in general representative of recent purchases, can be viewed as a cross-section of present-day practice since C-E is supplying steam generating units for virtually every classification of industry. It shows how completely C-E equipment serves the complete range of steam capacities from 1,000 to 1,000,000 lb per hr. It indicates that C-E has an unusually comprehensive line of boiler and fuel-burning equipment. It has real significance for the man who shoulders the serious responsibility of selecting the right steam generating equipment for his plant. It suggests that, regardless of his problem, C-E has the widespread experience to help him determine the one best solution as well as the right equipment for his particular needs. A-634

C-E

C-E CONTROLLED RADIANT BOILER



C-E RAYMOND BOWL MILLS

Capacity – 1,000,000 lb per hr. Design Press. – 1,800 lb. Steam Temp. – 955° F.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

IS USING TODAY!

STEAM PER HR

C-E TYPE VM BOILER

C-E TYPE E STOKER

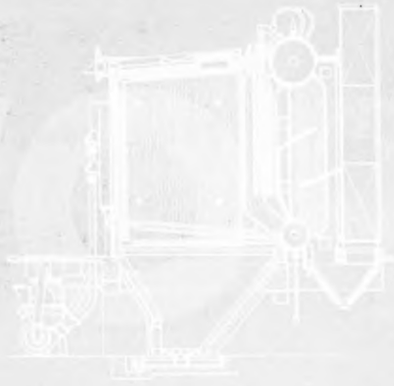
Capacity—23,000 lb per hr.
Design Press.—275 lb.

C-E TYPE VU-Z BOILER

C-E SPREADER STOKER

Capacity—38,800 lb per hr. Design
Press.—275 lb. Steam Temp.—505° F.

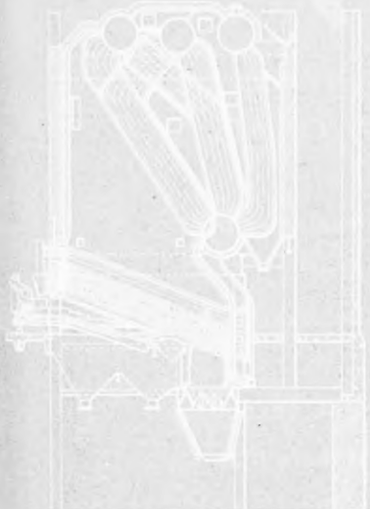
C-E VU STEAM GENERATOR



C-E RAYMOND BOWL MILL

Capacity—70,000 lb per hr. Design
Press.—450 lb. Steam Temp.—625° F.

C-E TYPE VA BOILER



C-E MULTIPLE RETORT STOKER

Capacity—90,000 lb per hr. Design
Press.—200 lb. Steam Temp.—371° F.

C-E TYPE VE BOILER

C-E TRAVELING GRATE STOKER

Capacity — 185,000 lb per hr. Design
Press.—1,425 lb. Steam Temp.—930° F.

C-E TYPE VE BOILER

C-E RAYMOND BOWL MILLS

Capacity — 285,000 lb per hr. Design
Press.—1,450 lb. Steam Temp.—915° F.

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING

MORE POWER *Continuously!*

IN THESE DAYS WHEN EVERY EXTRA HORSEPOWER OF ENERGY COUNTS, efficient operation is vital.

You will get more efficient continuous service from your turbines, Diesels, reciprocating engines and auxiliaries when you use *Texaco Power Plant Lubricants.*

Texaco Lubricants hold top position in various fields because they help reduce operating, maintenance and repair costs.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for National Defense.

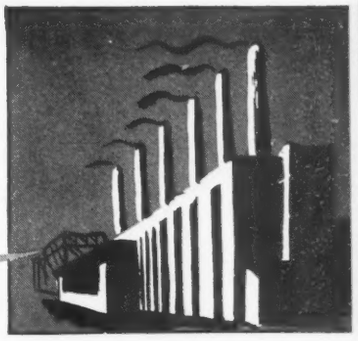
TEXACO

REG T.M.

TEXACO

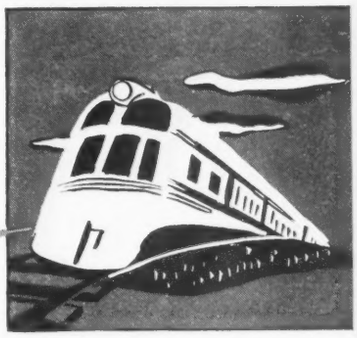
IN POWER-HOUSES . . .

More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.



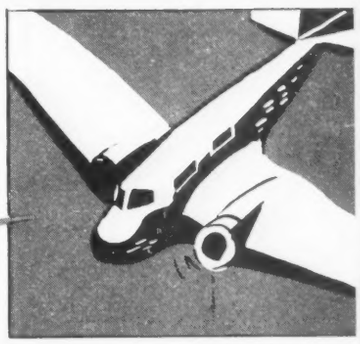
ON STREAMLINERS . . .

More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.



IN THE AIR . . .

More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

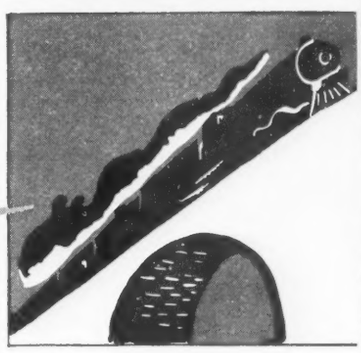


ON THE HIGHWAYS . . .

More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

ON THE RAILS . . .

More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.



FOR YOUR ENJOYMENT — TWO GREAT RADIO PROGRAMS

FRED ALLEN every Wednesday night. See your local newspaper for time and station.

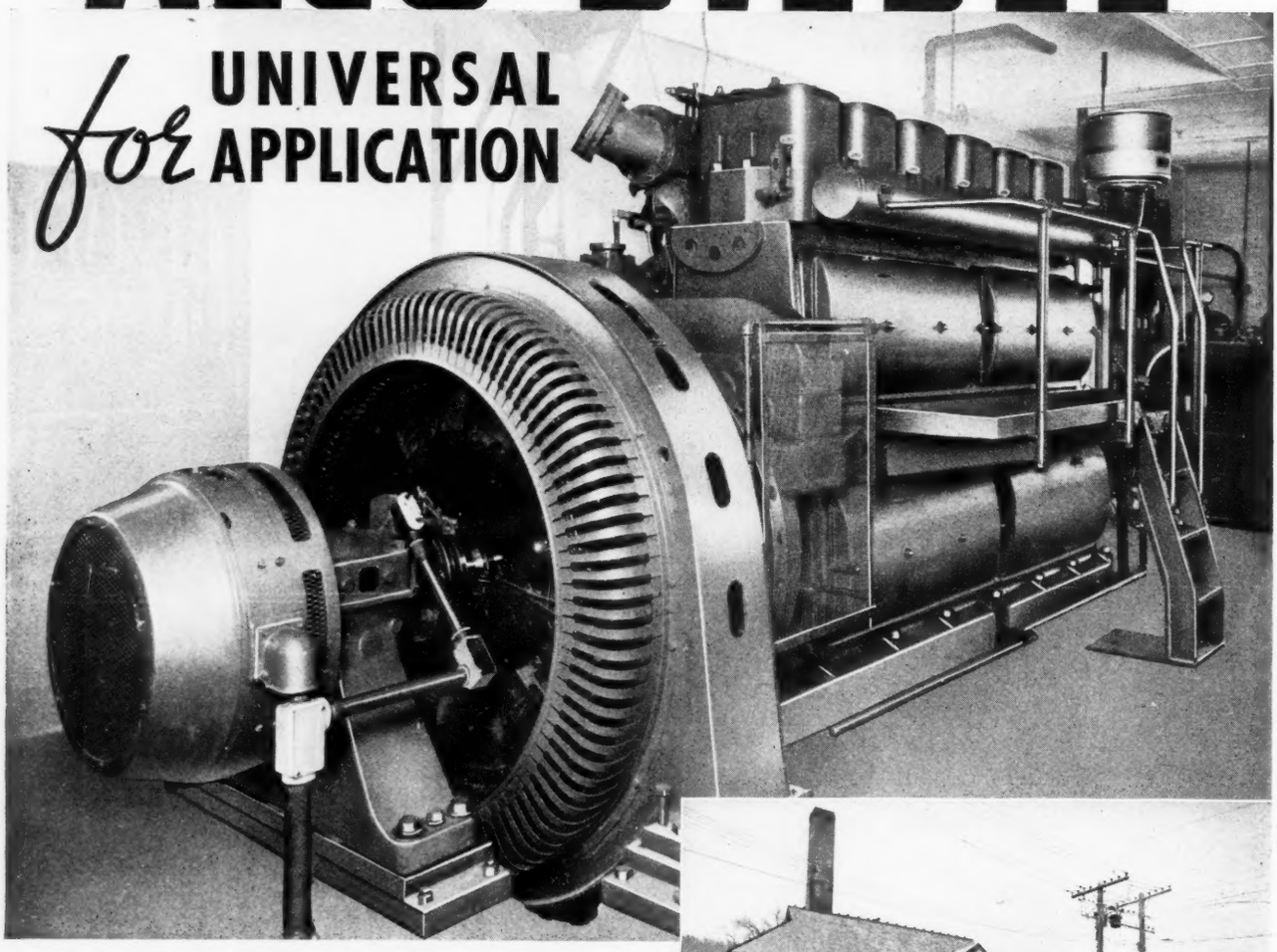
METROPOLITAN OPERA. Complete broadcasts of great operas every Saturday. See your local newspaper for time and station.

Lubricants and Fuels

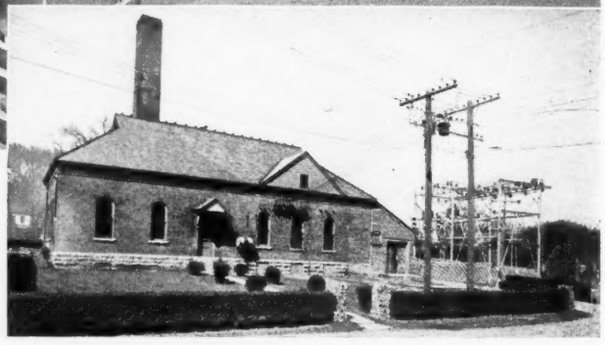
FOR POWER PLANT EQUIPMENT

ALCO DIESEL

for UNIVERSAL APPLICATION



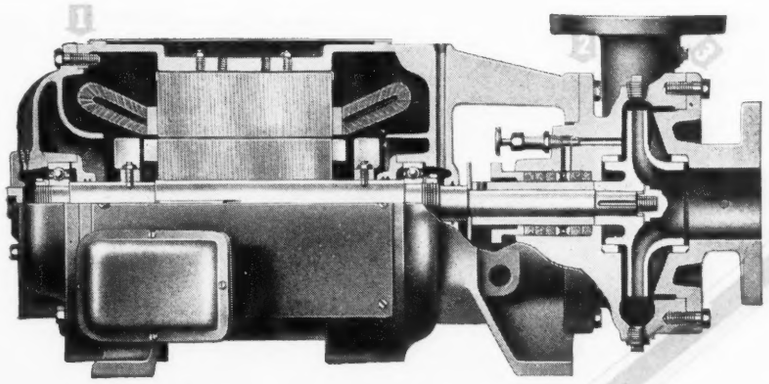
An Alco, 4-Cycle, 6-Cylinder, Diesel Engine rated at 540 BHP at 660 RPM was recently installed in the Municipal Power Plant of the Village of Skaneateles, N. Y. This Diesel was bought to take care of peaks, and carry the load of the village pumping plant, and all of the essential circuits during high line failures.



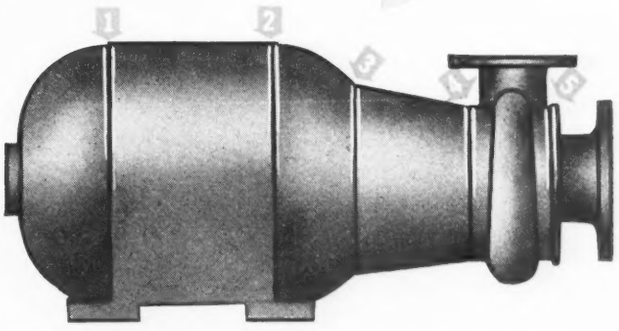
This Alco Diesel, due to its exceptional ruggedness, is eminently suitable for heavy duty services. It is in successful operation in Marine, Public Utility, Municipal and Industrial Power Plant Service.

DIESEL ENGINE DIVISION **AMERICAN LOCOMOTIVE COMPANY** AUBURN, NEW YORK

MAKE THIS 3 TO 5 TEST YOURSELF



There's less chance for faulty alignment in this "Tri-Fit" Design. The greater precision of only three section-fits cuts wear, cuts vibration, cuts trouble!



See how old-style motor pumps have five or more section fits, greater danger of faulty alignment, trouble-making vibration, more wear, less power!

And See How Allis-Chalmers "One Package" Pump Unit Eliminates Two Trouble-Making Fits and Saves You Up To 33%!

FEWER PARTS mean fewer headaches! That's one big reason the Allis-Chalmers "Electrifugal" Pump meets ...and beats every pumping challenge.

But we want you to be the judge. Check its new "Tri-Fit" construction yourself . . . and see why there's more positive alignment of the single shaft, less wear and tear . . . and smoother running, vibration-free operation.

Into this improved design has gone all the genius of Allis-Chalmers engineering experience. A new motor . . . 100% designed for pump drive . . . and *completely splash-proof* . . . gives greater mechanical strength.

One piece frame saves as much as 33% in space . . . 40% in overhang! Indestructible rotor and distortionless stator provide low maintenance and trouble-free service. Cast bronze protective sleeves, splash-proof ventilation and cast aluminum fans are other features that make this compact pump the choice of every industry.

Best of all . . . *you can actually cut your initial costs as much as 33% over conventional pump installations.*

For the money-saving details on this new "One Package" Pump . . . call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wisconsin, for Bulletin B-6140.

A 1434

Check These Great One-Package Features:

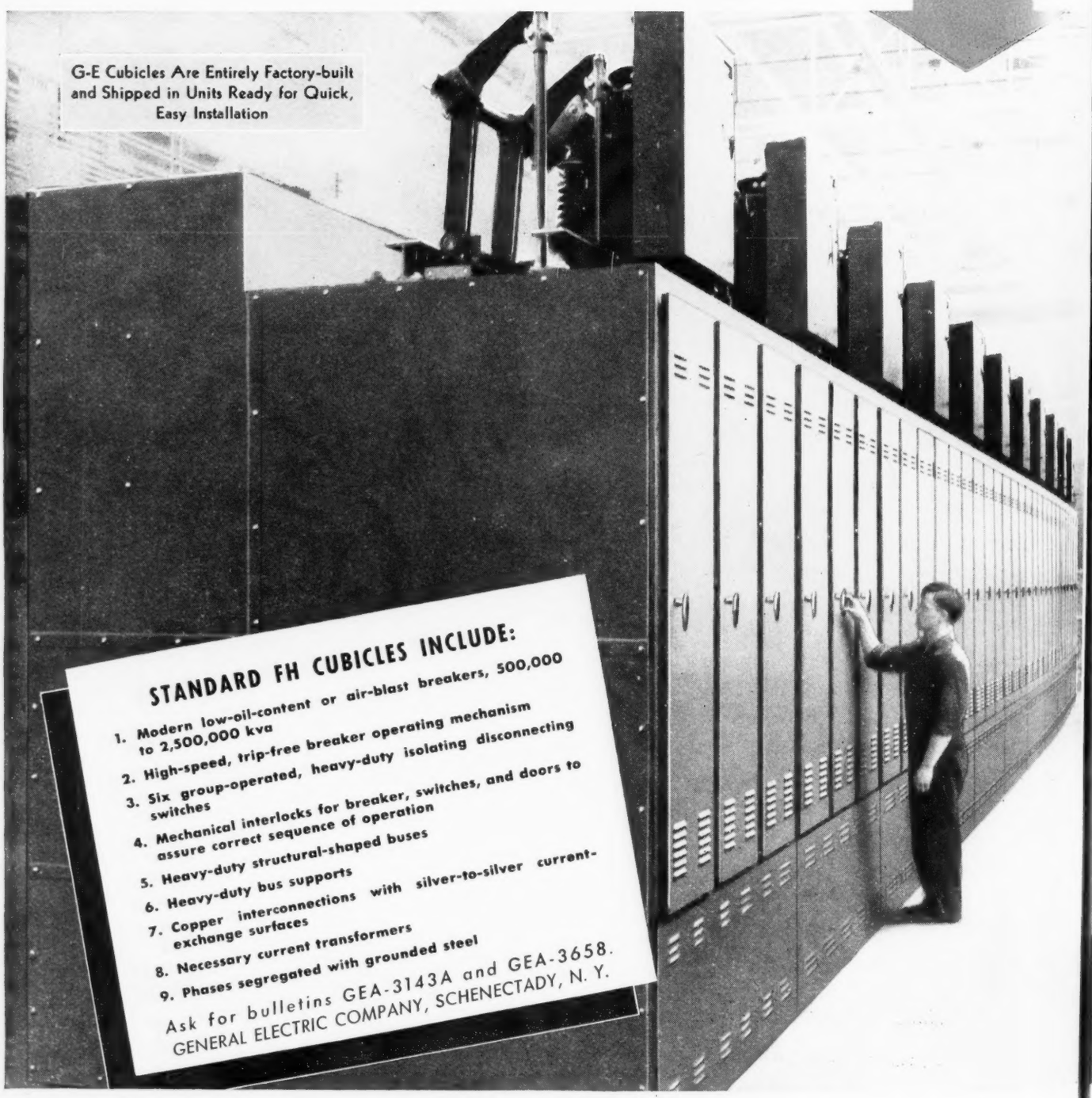
1. *Up to 33% Space Saved* with one frame, one solid driving shaft construction.
2. *Overhang Cut As Much As 40%.* Four solid supports assure precision balance . . . ease strain on vital parts.
3. *New Tri-Fit Design* eliminates 2 section fits for more positive shaft alignment, wear-less and vibration-free performance.
4. *Splash-Proof* Motor standard equipment . . . 100% designed for pumping.
5. *Easy-to-Get-at Casing* simplifies stuffing box and waterseal gland inspection.

Allis-Chalmers Pumps Can Handle "Anything that Flows"

ALLIS-CHALMERS
MILWAUKEE-WISCONSIN

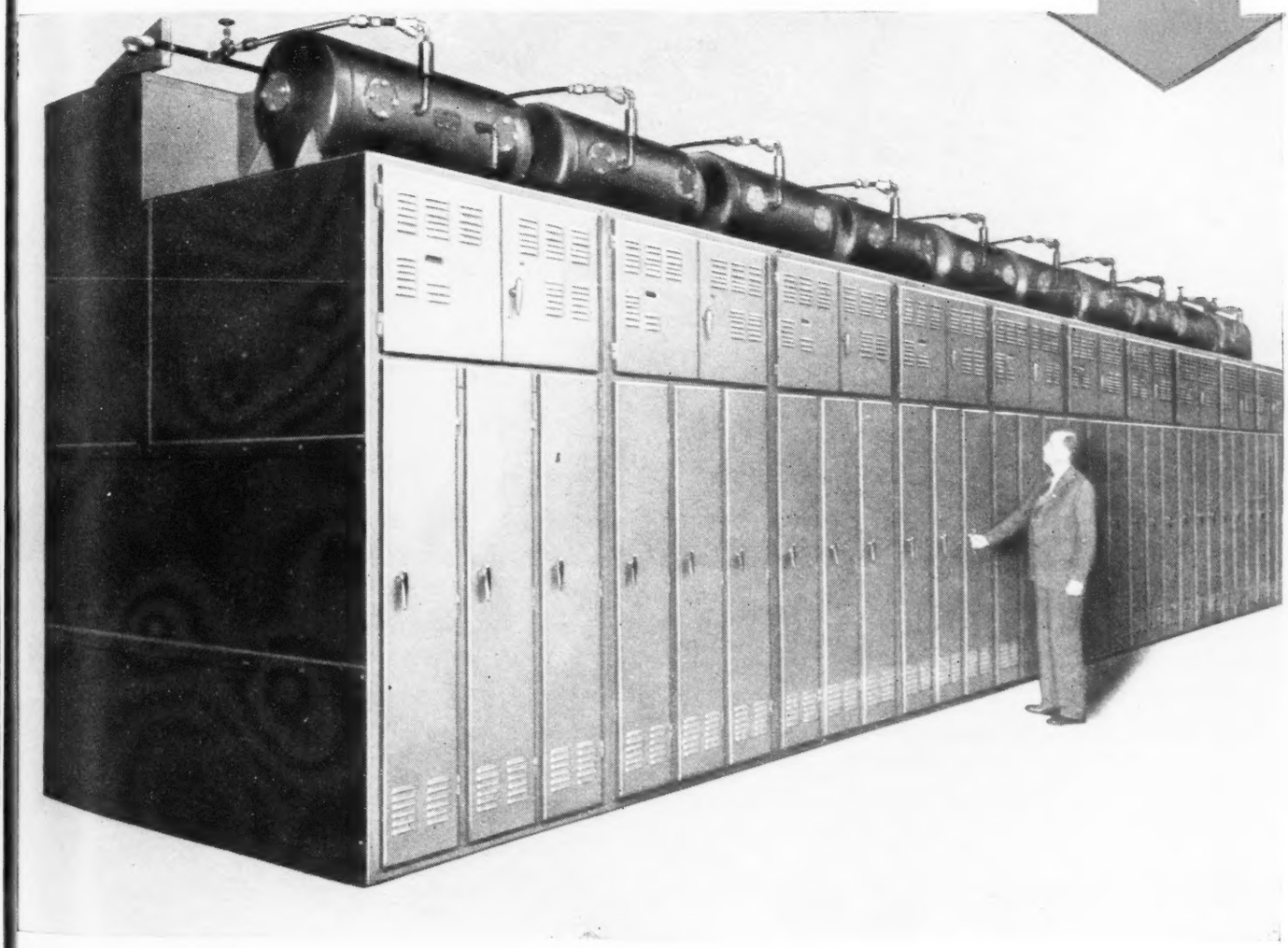
This Is THE SWITCHGEAR

FH CUBICLES with OIL-BLAST BREAKERS


G-E Cubicles Are Entirely Factory-built and Shipped in Units Ready for Quick, Easy Installation
STANDARD FH CUBICLES INCLUDE:
1. Modern low-oil-content or air-blast breakers, 500,000 to 2,500,000 kva
2. High-speed, trip-free breaker operating mechanism
3. Six group-operated, heavy-duty isolating disconnecting switches
4. Mechanical interlocks for breaker, switches, and doors to assure correct sequence of operation
5. Heavy-duty structural-shaped buses
6. Heavy-duty bus supports
7. Copper interconnections with silver-to-silver current-exchange surfaces
8. Necessary current transformers
9. Phases segregated with grounded steel
Ask for bulletins GEA-3143A and GEA-3658.
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

for ANY POWER STATION

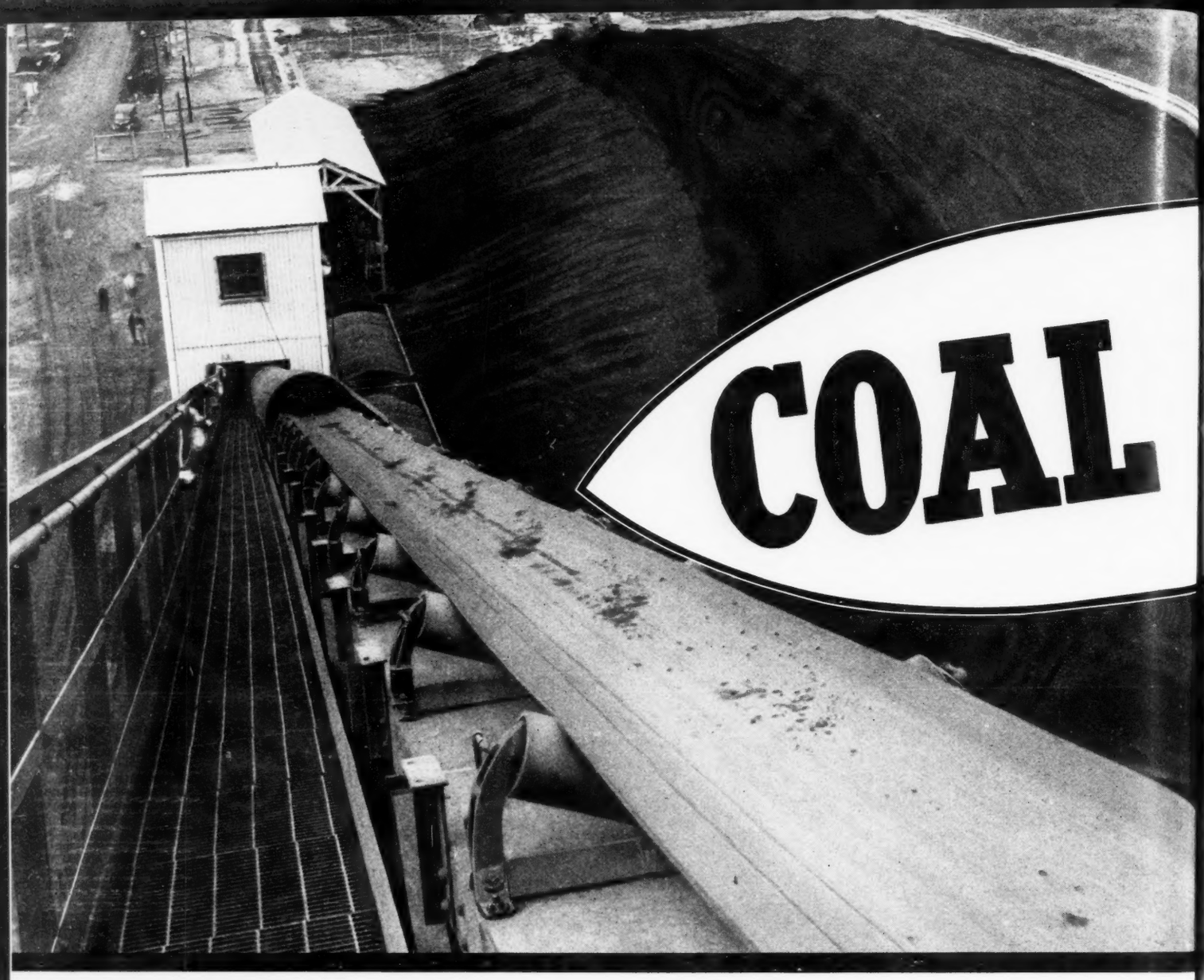
FH CUBICLES with AIR-BLAST BREAKERS



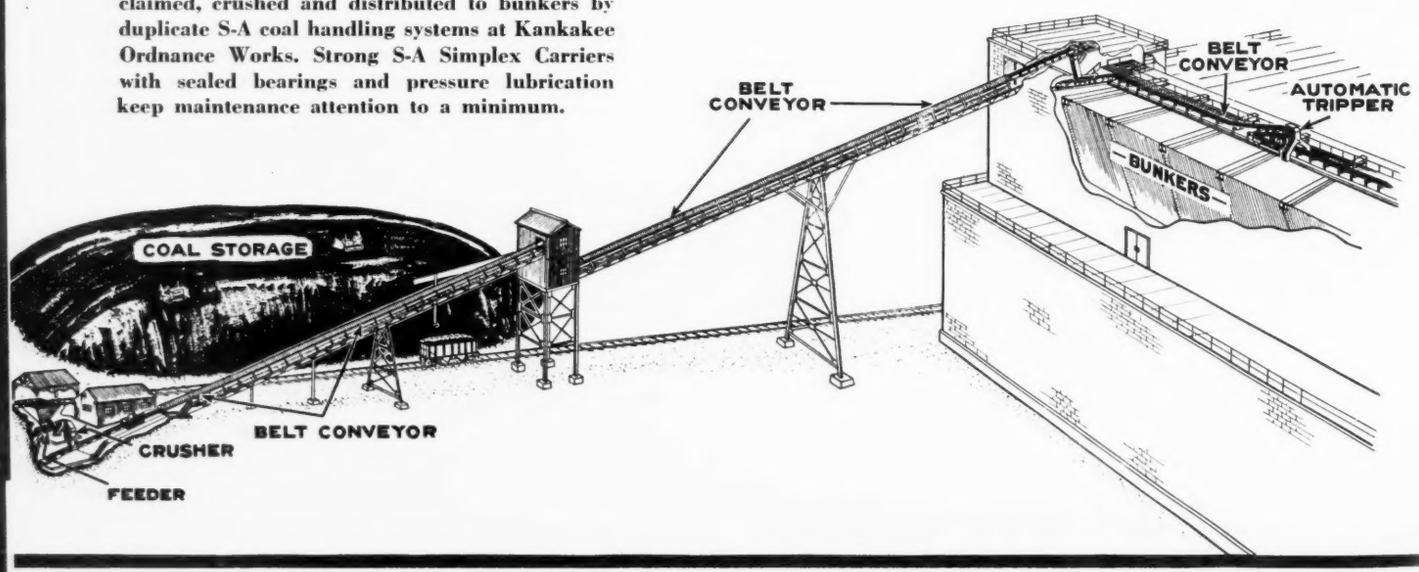
Compact, Segregated-phase Switchgear—a Complete Installation in Itself

FOR POWER-STATION SERVICE up to 23,000 Volts and 2,500,000 Kva

GENERAL ELECTRIC



LARGE COAL STORAGE piles are stored, reclaimed, crushed and distributed to bunkers by duplicate S-A coal handling systems at Kankakee Ordnance Works. Strong S-A Simplex Carriers with sealed bearings and pressure lubrication keep maintenance attention to a minimum.



STEPHENS-ADAMSON

WESTERN PLANT
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HANDLING

by S-A... for

KANKAKEE ORDNANCE WORKS

HUGE defense project for manufacture of explosives for artillery shells and aerial bombs at Kankakee Ordnance Works, in 35 square mile area in northern Illinois, requires large volumes of processing steam.

Duplicate power plants in the area, equipped with complete Stephens-Adamson Coal Handling machinery, are basic parts of the project.

All power plant Belt Conveyors, Trippers, Feeders, Hoppers and Drives are products of S-A.

Engineers were long-established Stone and Webster, Boston.

While U. S. is owner of project, E. I. du Pont de Nemours and Company are directing plant operation, providing the defense program with benefits of their years of experience and research in chemical production.

• • • •

Write us for Engineering Data Books on any phase of your coal or ash handling problems.

Stephens-Adamson Mfg. Co.

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COMPLETE MATERIAL HANDLING

. . . for any job, from the largest to the smallest . . .

- Apron Conveyors
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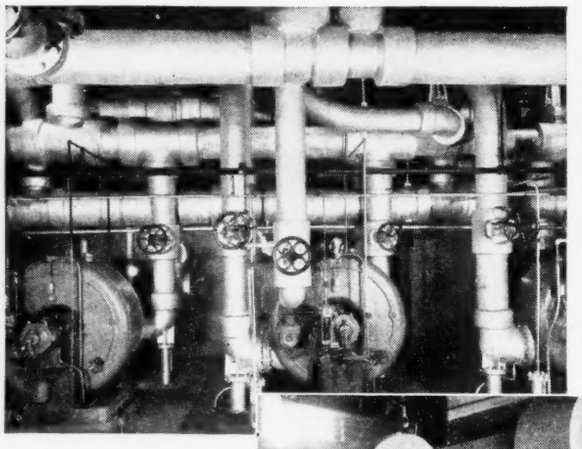
3-WAY COMBINATION FOR

Durable and unusually efficient, these J-M Power Products last longer with less maintenance . . . give improved performance wherever used . . .

1 J-M INSULATIONS

ON BOILERS . . .

Where insulation is required to resist temperatures between 600° and 1900°, J-M Superex Blocks are ideal. Even under severe operating conditions, this durable material gives long, efficient service . . . offers maximum protection against costly heat losses. Use L-W Superex up to 1500° F.; H-T Superex between 1500° and 1900° F.

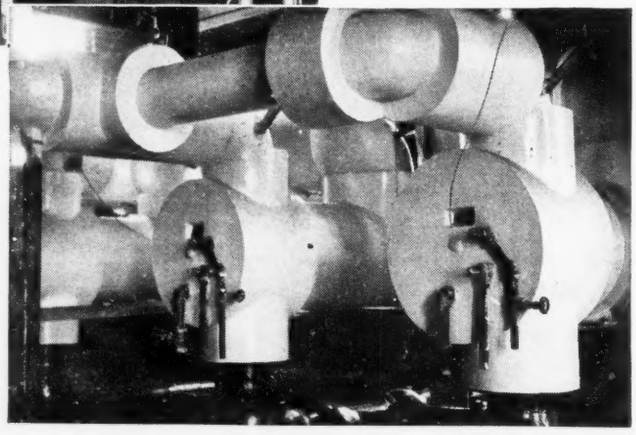


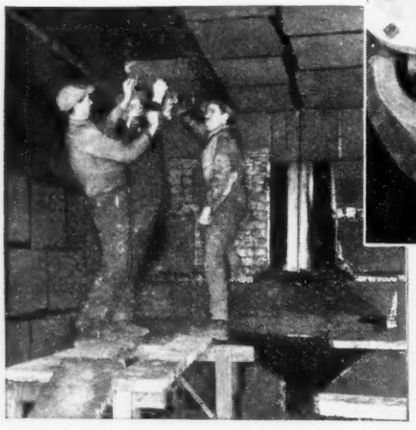
ON SUPERHEATED STEAM LINES . . .

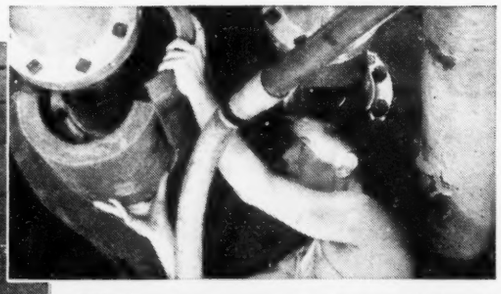
The new Johns-Manville L-W Superex provides an effective safeguard against excessive heat waste. Recently developed by the J-M Laboratories to meet the need for a more efficient high-temperature pipe insulation, it offers exceptional heat resistance and unusually high insulating value.

FOR LINES UNDER 600°

. . . You save money by using J-M 85% Magnesia Pipe Insulation. For many years the standard insulation for steam lines, it combines light weight with high insulating efficiency.







FOR LOW TEMPERATURES

. . . J-M Rock Cork has been giving low-maintenance service for more than thirty years. Supplied in both sheet and pipe-covering form, it is basically mineral . . . does not burn, rot or decay. Unusual moisture-resistance assures permanently high insulating efficiency.

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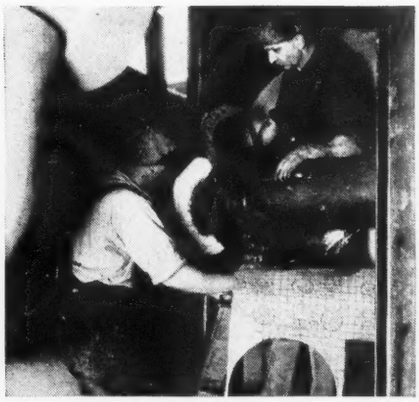
LOWER POWER-PLANT COSTS

2 J-M PACKINGS AND GASKETS



AGAINST STEAM, AIR, BRINE, OIL . . .

J-M Sea Rings are ideal for rods and plungers. Entirely automatic, they seal on work stroke, release on return . . . minimize rod wear.

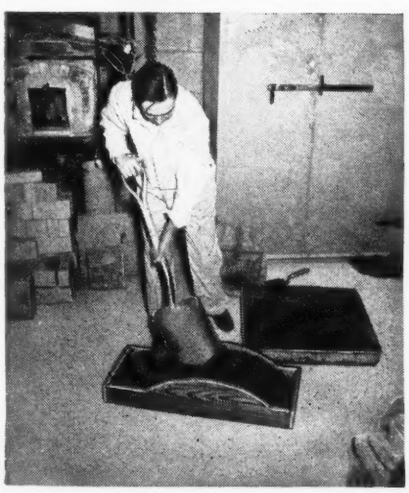
ON FLANGES . . .

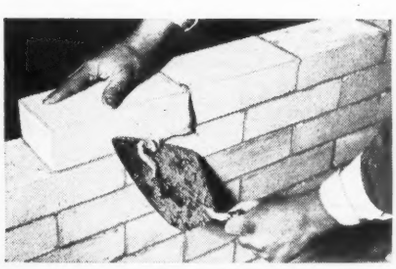
and other parallel surfaces, it will pay you to use J-M Service Sheet. It is dense, yet resilient . . . always uniform in quality. Stocks may be carried indefinitely, for it does not deteriorate with age.

FOR BOILER HANDHOLES AND MANHOLES . . .

J-M Kearsarge Gaskets form perfect seals every time. Made of specially treated Asbesto-metallic cloth, they assure long life, low maintenance.

3 J-M REFRACTORY PRODUCTS





FOR BONDING . . .

You get strong, tight joints with these J-M Refractory Cements: Hellite, air-setting—for bond or cushion joints; No. 31, heat-setting—for bond or cushion joints; No. 32, heat-setting—for brick-to-brick joints. Hellite and No. 32 also used for washcoating.

FOR SPECIAL SHAPES . . .

Cast your own shapes with J-M Firecrete. Air-sets, handles like concrete, forms any shape. Also ideal for poured door linings. 3 types: Standard (2400°), High Temp. (2800°), Light Weight (2200°).

POWER PRODUCTS

These well-known J-M materials are saving money for thousands of plants all over the country. The materials shown on these pages represent only a small part of the complete J-M line of Power Products. You should have full details on them all. Write for catalog GI-6A. Address Johns-Manville, 22 E. 40th St., New York, N. Y.

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SAVE HEAT WITH
EHRET INSULATIONS
MAKERS OF INDUSTRIAL

INSULATION...

FOR EVERY POWER PLANT NEED

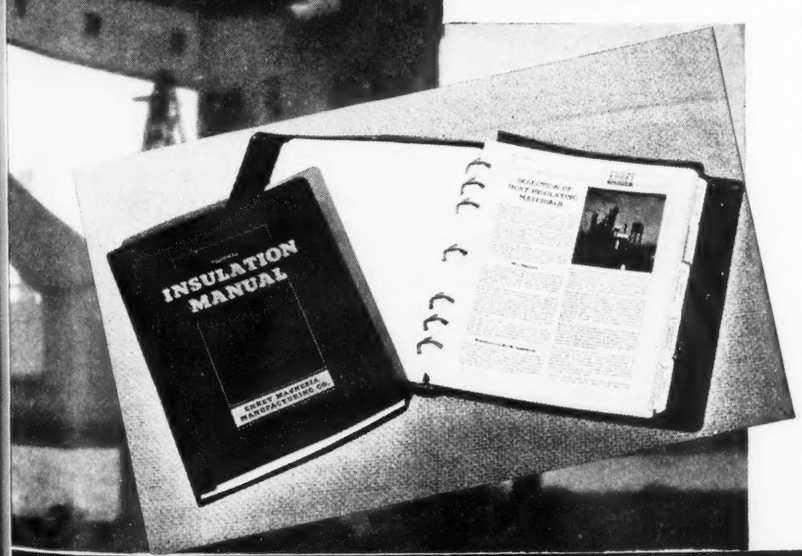
With upwards of 40 years' experience in the field of heat insulation, the Ehret line has been developed and expanded to cover the wide range of temperatures and operating conditions of today. Ehret insulation specialists are available to discuss insulation problems, make recommendations, furnish materials and make applications to render the highest insulating efficiencies.

Ehret Insulations of 85% Magnesia are standard for boilers and lines under 600°F. Combine minimum weight with maximum insulating efficiency. Furnished in all standard sizes of pipe coverings, flat and curved blocks, as well as special sizes and shapes.

Ehret's Enduro used with 85% Magnesia for temperatures from 600°F to 2000°F in standard sizes and lengths of pipe coverings, flat and curved blocks, as well as special sizes and shapes.

In addition, Ehret's Durant Insulated Pipe—in pre-sealed factory-fabricated units—provides unusual advantages for underground steam lines.

Also, Insulating Blankets, Asbestos Felted, Cold Insulations, Insulating Cements, Valley Forge Packings. Write for full information on Ehret Products and Ehret Service.



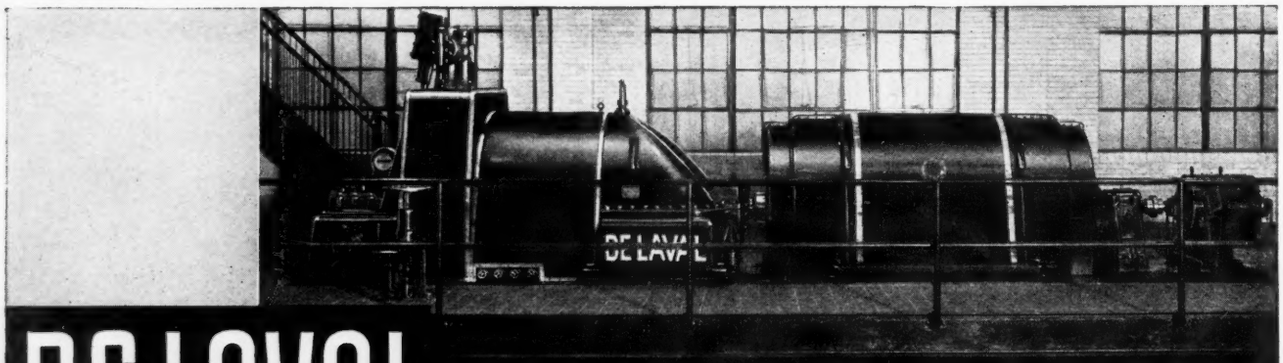
◀ THE EHRET MANUAL OF THERMAL INSULATIONS

The Ehret Insulation Manual is a practical handbook containing nearly 300 pages of information on the selection and application of Insulations and other Ehret Products. Copies are available to key personnel in the power field.

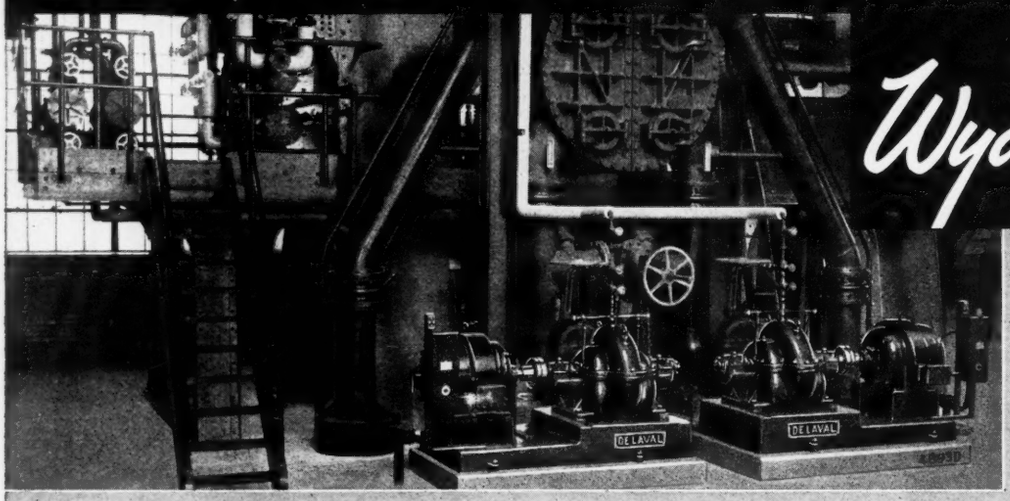
EHRET MAGNESIA MANUFACTURING COMPANY

VALLEY FORGE • PENNSYLVANIA

INSULATIONS FOR MORE THAN FORTY YEARS



DE LAVAL TURBO-ALTERNATOR at Wyandotte



IN 1938, the City of Wyandotte, Mich., placed an order for a De Laval turbo-alternator to generate 4,000 kw. (5,000 kw. maximum) from steam at 425 psi. and 720° F., to be operated condensing, but with bleeder connections for feed heating and for heating the Wyandotte City Hospital. This unit, which has been in continuous service since January, 1940, operates in parallel with an older 2,000 kw. generator and with the power system of the Michigan Alkali Company.

The turbine is of the impulse type, with ample bucket clearances and with provisions to equalize expansion. An accurate and sensitive fly-weight governor controls the admission valves through two stages of hydraulic relay amplification and can be set manually or by the remote synchronizing device. The entire governor mechanism is housed in the turbine base, without exposed piping or mechanism.

Constructional details have been designed for high pressure, high temperature steam, with segregation of moisture in the low pressure stages.

The installation includes De Laval condenser circulating pumps, condensate pumps, boiler feed pumps and lubricating oil purifier. A similar De Laval unit rated at 6,000 kw. has since been ordered.

Further particulars are given in Leaflet T-3521, sent upon request

DE LAVAL Steam Turbine Co.
TRENTON, N. J.

MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL; and FLEXIBLE COUPLINGS

POWER

MID-DECEMBER, 1941

Buyers' Guide Number

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Combustion of Pulverized Fuels and Burner Design 102

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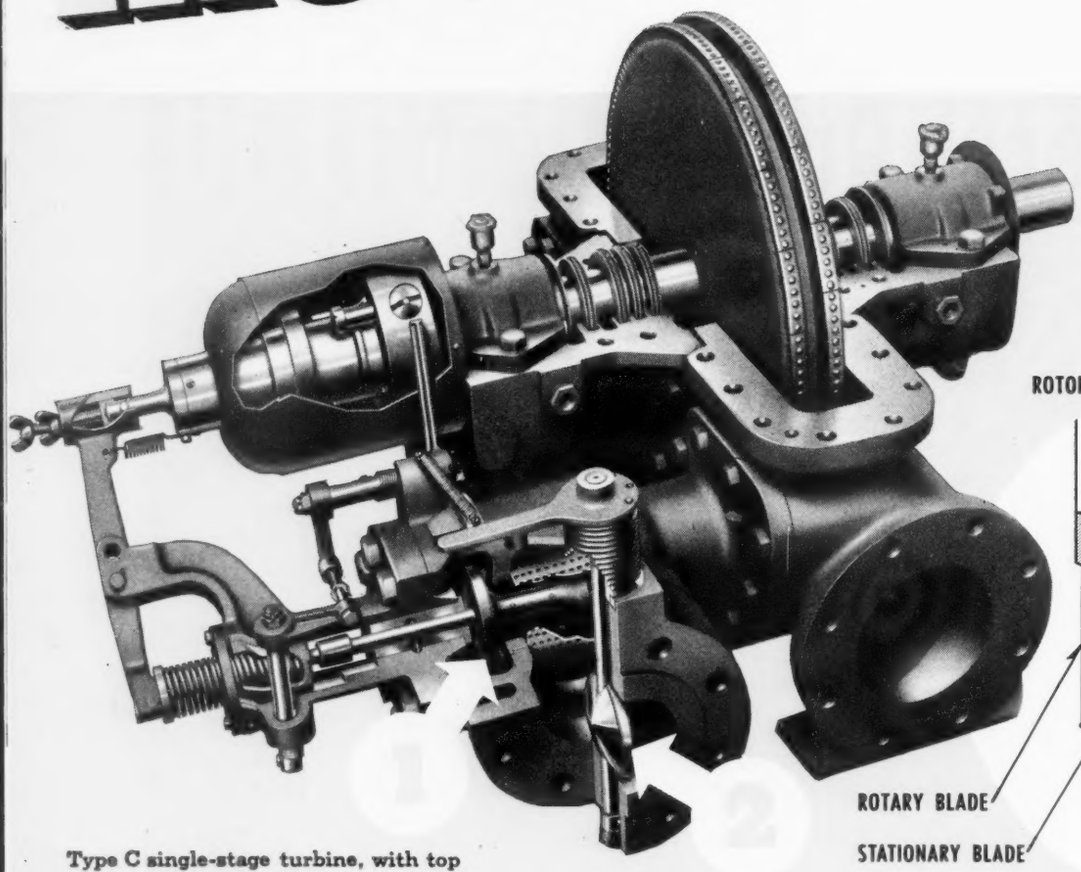
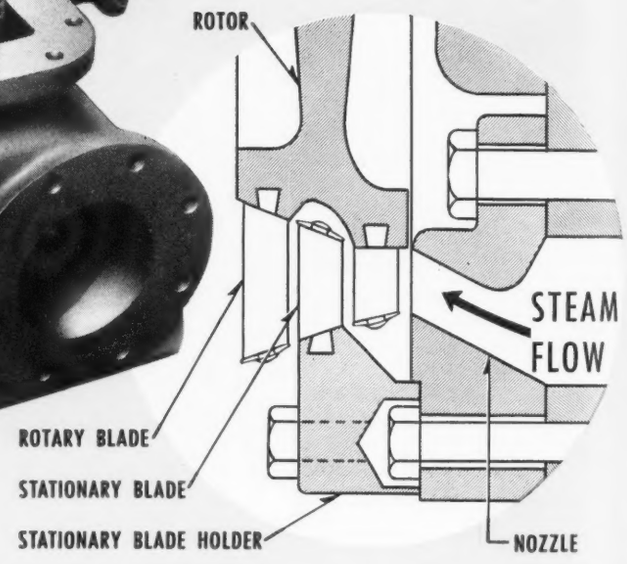
most turbine



Type C single-stage turbine, with top of casing removed. Cutaway shows Dual Protection overspeed trip linkage, which actuates *both* the governor valve (1) and the butterfly valve (2) at the *same time*, when overspeed occurs.

See how the steam path is contoured for maximum efficiency. Blade pitch is uniform. Blade shrouding is made conical to approximate the steam expansion characteristic. Nozzle dimensions are accurate.

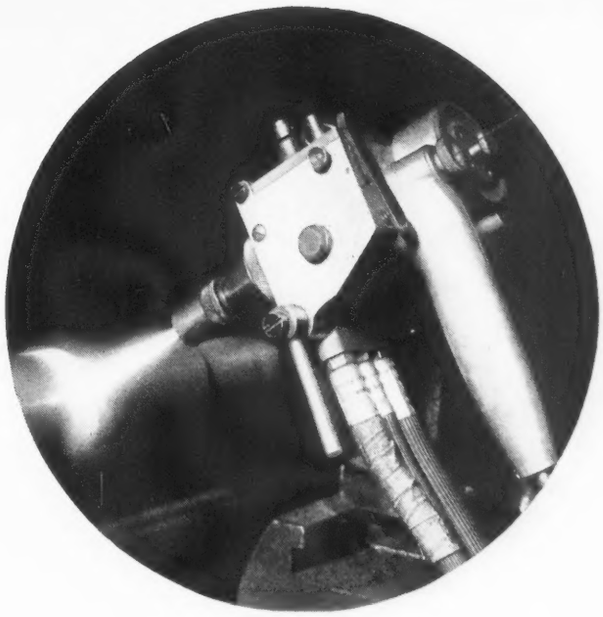


ONLY WESTINGHOUSE TURBINES HAVE *ALL* THESE FEATURES:

- DUAL PROTECTION—Overspeeding trips both valves at once.
- Sparkless overspeed trip, with Micarta insert, when required.
- SHAFT PROTECTION—Sprayed with high chrome-nickel steel at the gland zones.
- Generous number of carbon rings.
- One-piece disc, shrunk and keyed onto shaft. Protected by corrosion-resistant paint.
- Rotor balanced dynamically.
- Chrome-alloy blades.
- Shrouding secured by spun blade tenons.
- Steam path contoured for efficiency.
- Heavy-duty hand valve with bolted bonnet.
- Powerful, sensitive governor.
- Cored water chambers for oil cooling.
- No soft packing on the inlet valve stem.
- Steam strainer about inlet valve.
- Heavy construction.
- Ground horizontal joint—no gasket.
- High-temperature aluminum finish.

Westinghouse

FOR THE MONEY!



How Westinghouse General Purpose Turbines give you extra reliability, extra safety, extra economy

Whether it serves as a small 20 hp pump drive or a large 100,000 kw turbine-generator, each Westinghouse turbine is evidence of Steam Headquarters' contributions to turbine design. Over 20 million horsepower of turbine experience is built into every Westinghouse machine.

Here's what we mean when we say *Steam Headquarters gives you the most turbine for your money . . .*

Only Westinghouse offers these *five* essential protective features:

DUAL PROTECTION—Through a special linkage, *both* the governor valve and the heavy-duty butterfly valve are tripped *at once* when overspeeding occurs . . . assuring positive steam shut-off.

EXPLOSION PROTECTION—A sparkless overspeed trip lever, with Micarta insert, is supplied with turbines which are to operate in explosive atmospheres.

ROTOR PROTECTION—The disc is coated with corrosion-resistant paint, so that original shape and balance are maintained.

SHAFT PROTECTION—Rotor shaft is sprayed with high chrome-nickel steel at the gland zones to prevent rust-cutting of the carbon rings.

CASING PROTECTION—Red lead and high-temperature aluminum paint give the turbine casing a protective covering that will stand up under severe operating conditions.

These extra points of protection are typical of the many *plus* features of Westinghouse turbines—design progressiveness that gives you higher standards of reliability, safety and economy.

You get more than turbines at Steam Headquarters. At Westinghouse, you have the advantages of a complete line of steam equipment from which to select, competent engineering help in application problems, and a nationwide maintenance service as convenient as your telephone. Write for Booklet 2230. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-50359

WHAT IS SHAFT PROTECTION?

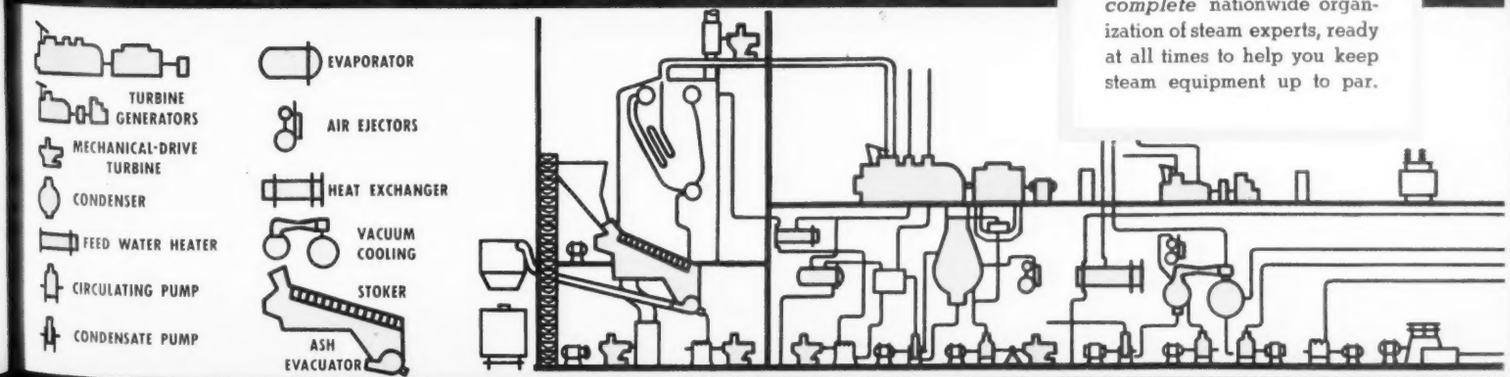
To prevent steam leakage and consequent oil contamination caused by rust-cut carbon gland segments, Westinghouse sprays each turbine shaft with a generous thickness of high chrome-nickel steel at the two gland zones. Shaft is grooved, undercut and knurled to provide a permanent anchor for the sprayed metal, which is fed from a wire roll and applied with an oxyacetylene torch. After spraying, the entire shaft is finish-ground.

EQUIPMENT — A *complete* range of steam turbines for mechanical or generator drive, from 5 hp upward . . . with a full line of auxiliary steam equipment.

ENGINEERING — A *complete* and competent engineering service to help you select and apply the steam equipment best suited to your requirements.

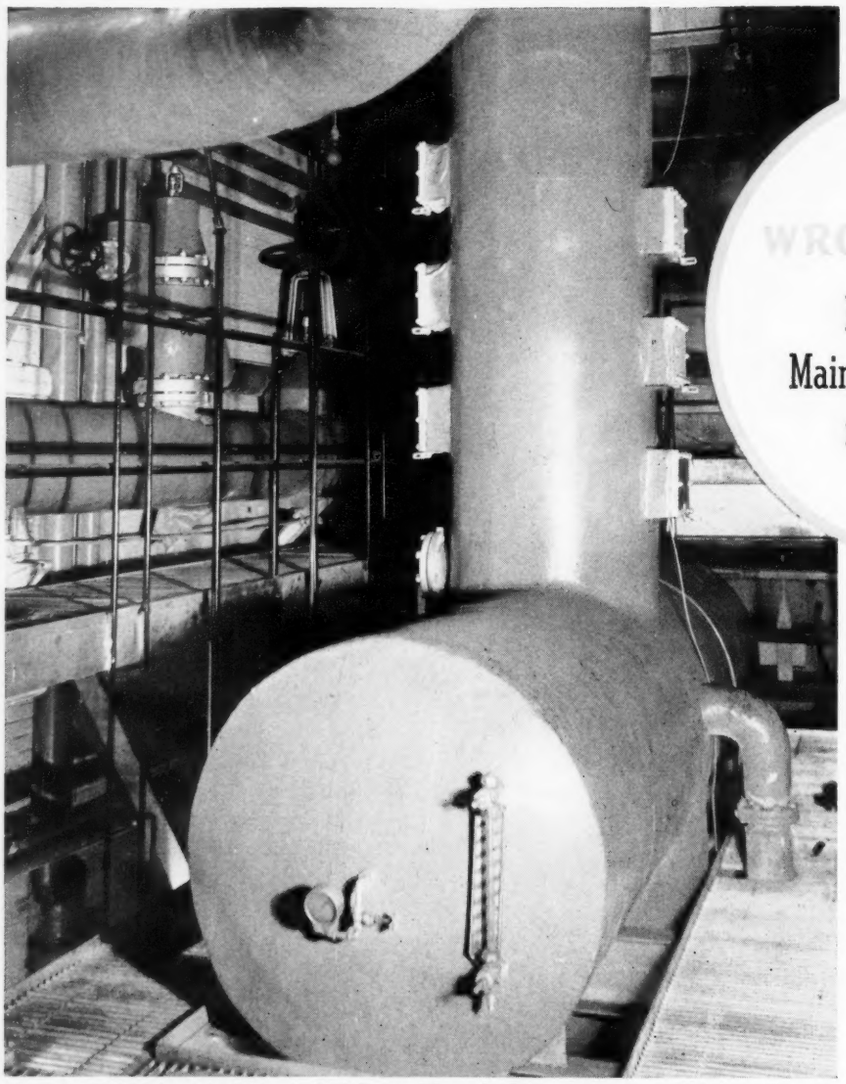
MAINTENANCE — A *complete* nationwide organization of steam experts, ready at all times to help you keep steam equipment up to par.

THE STEAM HEADQUARTERS LINE IS COMPLETE



STEAM HEADQUARTERS

WESTINGHOUSE ELECTRIC

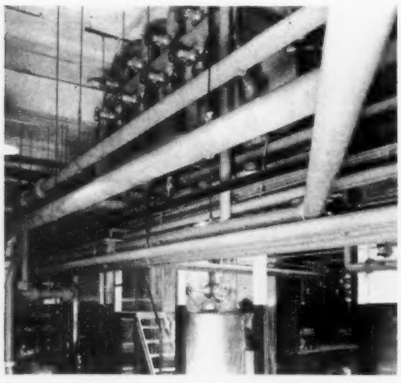


This "T" shaped tank, fabricated of Byers Wrought Iron plates, is used for condensate storage, and also to store make-up water. Almost every engineer recognizes the value of wrought iron for return lines . . . and these tanks are naturally exposed to the same service conditions. A large house water tank is also wrought iron.

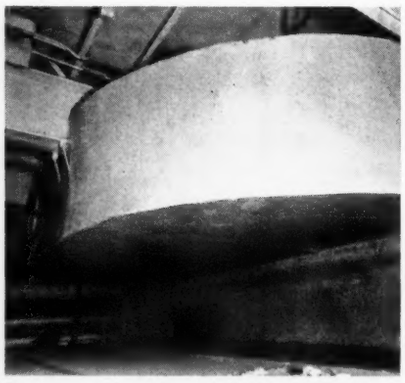
BYERS
WROUGHT IRON

Helps to solve Maintenance Problems in 11 Services Here . . .

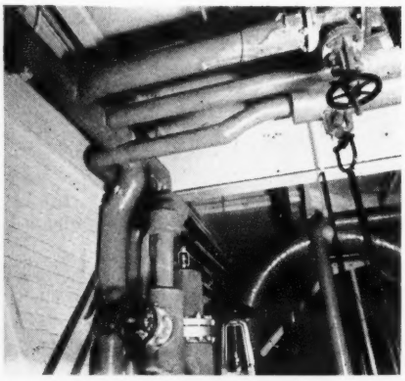
At the Crowell-Collier Publishing Company plant in Springfield, Ohio, Chief Engineer Axel Lundbye makes extensive use of wrought iron in solving maintenance problems. It has been successfully utilized in 11 applications. If you have any services where (a) corrosion, or (b) fatigue are causing premature failures of ordinary materials, by all means investigate wrought iron. Our Engineering Service Department will give you authentic service data on actual performance in similar jobs. Also ask for our Technical Bulletin, "Wrought Iron for Tank Construction." A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.



The lines shown here include cold water return lines from Air Compressor, water lines from bearing coolers, high pressure (200#) steam, and exhaust lines . . . all wrought iron.



The economizer breeching shown is made of Byers wrought iron. The material was also used in water cylinders on the printing presses, and for sucker rods on the deep well pump.



Wrought iron was installed for condensate return lines to the "T" tank above. Also, (not shown) in condensate return lines and hot and cold water lines which are buried under the floor.

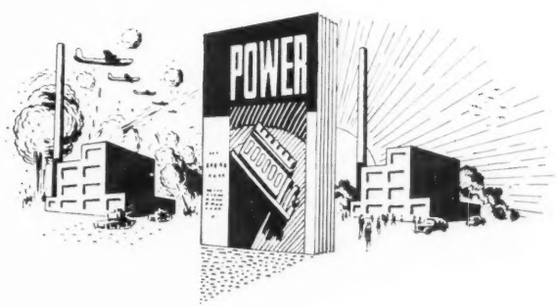
Corrosion costs you more than Wrought Iron

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS
STEEL TUBULAR PRODUCTS

POWER

Established 1882 • PHILIP W SWAIN, Editor



GUIDE FOR 1942

Once again POWER presents its annual guide for the coming year. Once again the editors have assembled pertinent information on new and improved boiler equipment, diesel and gas engines, meters, pumps, valves, etc, (page 58), as well as reviews of over 350 manufacturer's new bulletins and catalogs (page 114). Digests of papers presented at the annual meeting of the American Society of Mechanical Engineers form an important part of this issue (page 89), while an enlarged Buyers' Guide aids the power engineer in locating the maker of products or equipment needed in his plant (starts on page 179).

The general character of this issue, as a concise practical review of the year's new equipment, new bulletins and new thinking, was established in the years when America heard nothing of shortages and priorities—when defense was not yet a fact and hardly a slogan. The same *kind* of information, in the same general form, is presented this December because it fits the needs of a time when America is becoming in fact the "Arsenal of Democracy."

Just as surely it will fit again when the fighting is over and the nation returns to peaceful pursuits, for the simple reason that power men can serve best in either war or peace by doing their power job in the most efficient manner.

Review of Power and Mechanical Equipment

In the pages that follow, POWER *presents its fourteenth annual review of new and improved equipment. The descriptions presented here are summaries of those which have appeared in* POWER *since January 1, 1941, plus additional items received in the past month.*

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BOILERS, STOKERS, TURBINES AND ACCESSORIES

BOILER-WATER COMPARATOR—Plastic outfit operating on slide principle determines pH and phosphates in boiler water. Phosphate and pH slides work on same base, and all equipment contained in portable wooden case. *W A Taylor & Co, Inc, 7300 York Rd, Baltimore, Md.*

SMOKE ALARM — Worner "Fotoelectric" smoke alarm has two mounting flanges, placed on opposite sides of breeching. When predetermined density of smoke passes through light beam provided, photo cell registers this on meter on panel door. Relays can be furnished to operate valves, dampers, etc, if necessary. *Worner Products Co, 1019 W Lake St, Chicago, Ill.*

FIREBRICK—New line announced for temperatures from 1600 to 2600 F, for direct exposure, except where subject to slag action or mechanical abuse. Produced from plastic refractory clay and organic filler. *Johns-Manville, 22 E 40th St, New York, N. Y.*

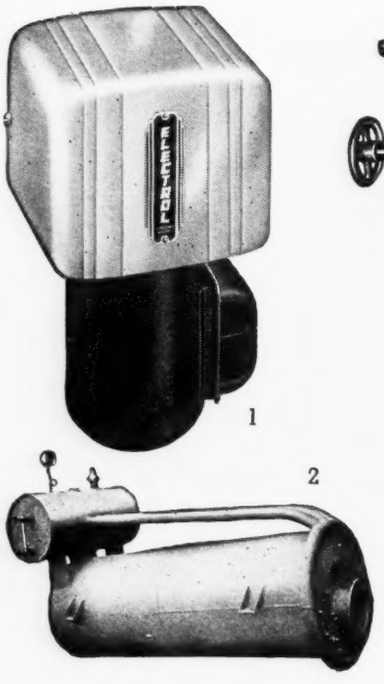
1 OIL BURNER—Model LF is air-atomizing type burner suitable for ignition torches in boilers, etc. Instead of high-pressure pumps, atomization is obtained by jet of compressed air provided by small compressors. *Electrol, Inc, 934 Main Ave, Clifton, N. J.*

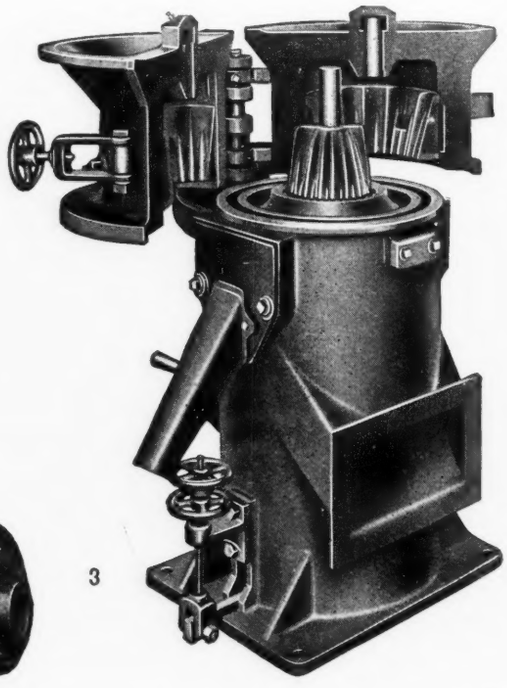
2 WASTE-HEAT BOILER — Combination waste-heat boiler and silencer recovers heat by arrangement of angle irons, at same time providing effective silencing. Can be combined with spark arrestor where necessary, and is designed around Universal silencer principle originated by company. *Maxim Silencer Co, 85 Homestead Ave, Hartford, Conn.*

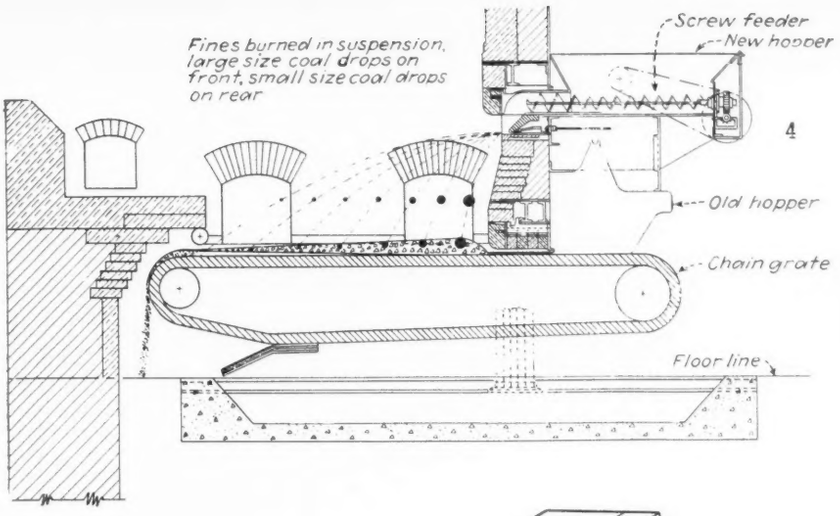
3 COAL CRUSHER AND SAMPLER—Sturtevant machine crushes 3-in. and smaller coal and coke at 1 ton per hour to approximately 8 mesh and smaller, with large percentage of 20 mesh and finer. At same time unit automatically picks out representative 5, 10 or 15% sample of all coal or coke passed to it. Furnished for either belt or motor drive. *Sturtevant Mill Co., 171 Clayton St, Boston, Mass.*

4 STOKER—Illustration shows application of "Fyr-Feeder" spreader stoker in conjunction with regular chain-grate stoker. Equipment consists of additional hopper screw and blast of air. Said to provide increased capacity, thinner fuel bed and automatic control. *American Coal Burner Co, 155 E Superior St, Chicago, Ill.*

5 DRUM SEALING RINGS—Reintjes rings used for stopping air infiltration around boiler drums, due to brick cracking, arches, etc. Metal sleeves, shown in illustration, per-






Fines burned in suspension, large size coal drops on front, small size coal drops on rear
Screw feeder
New hopper
Old hopper
Chain grate
Floor line

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mit endwise movement of drums without pressure against walls. *Geo P Reintjes Co, 2517 Jefferson St, Kansas City, Mo.*

6 TUBE-COATING MACHINE—"Apexior" machine operates with air-motor agitation. With operating hose lengths up to 150 ft connected to working line up to 75 ft long, operator can pass brush through tube. Coating is discharged into path of rotating brush as coating unit is withdrawn. *Dampney Co of America, Hyde Park, Boston, Mass.*

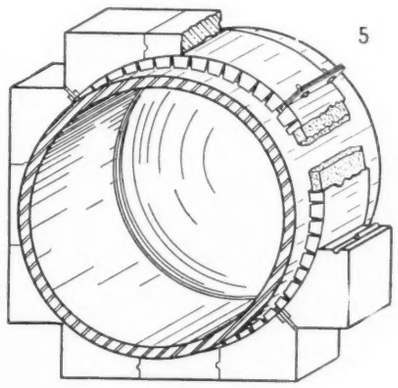
7 TUBE CLEANER—NEMCO solution-feed sanitary pipe and tube cleaner consists of solution tank mounted on ball-bearing casters with totally enclosed motor on top of assembly driving compressor. Solution is forced from tank by air pressure created by compressor. Scrubbing handles furnished, as well as tube cleaning shafts from 3 to 10 ft, suitable for tubes from $\frac{7}{8}$ to 6 in. ID. *National Electric Mfrs Co, 60 E 42nd St, New York, N. Y.*

8 FLUE-ROLLING MACHINE—Sizes 55-Q and 55-R flue-rolling machines powered by "Multi-vane" air motor. Units constructed especially for rolling extra-large tubes, tapping for, running in or removing large pipe plugs. *Ingersoll-Rand Co, Phillipsburg, N. J.*

9 CONDENSER—Straub degassing condenser removes carbon dioxide, oxygen, ammonia and hydrogen from samples of steam or condensate. In operation, unit boils degassed condensate to furnish a gas-free steam which in turn degasses the continuously supplied untreated condensate. Gas-free sample flows out of unit for determination of dissolved solids by conductivity method. *W. H. & L D Betz, Gillingham and Worth Sts, Frankford, Philadelphia, Pa.*

10 BOILER-WATER CONTROLS — Electrodes, see illustration, of different lengths, are suspended in chamber which can be mounted on water-glass column. When boiler water level falls below longer electrode, electrical circuit is disturbed. This operates a relay and starts pump and keeps it pumping till water reaches short electrode. Two models now available for electric- or steam-driven pumps. *Johnson Corp, Three Rivers, Mich.*

11 FLAME CONTROL—Mercoid "Visaflame" control is light-actuated mercury switch designed to operate in conjunction with Mercoid safety control panels as power, ignition and flame-failure shut off for oil burners. Circuit remains closed in presence of flame, open without it. Device should not be confused with photo-cell-actuated switch. *Mercoid Corp, 4201 Belmont Ave, Chicago, Ill.*



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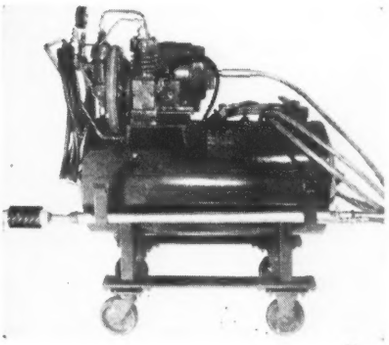

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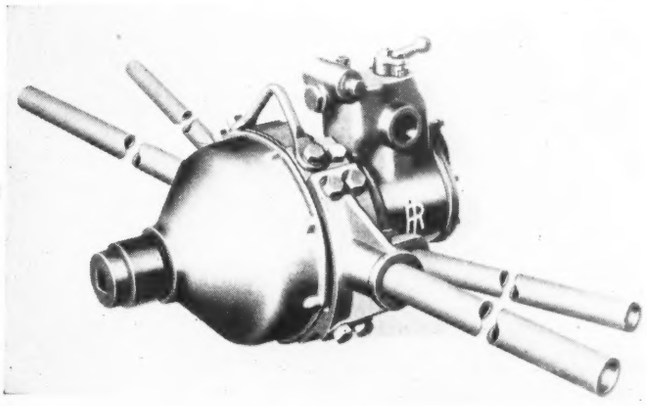

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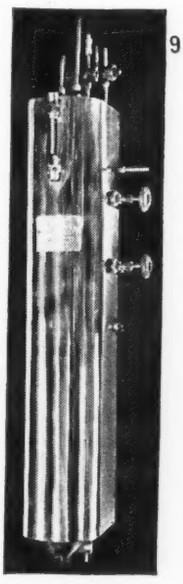

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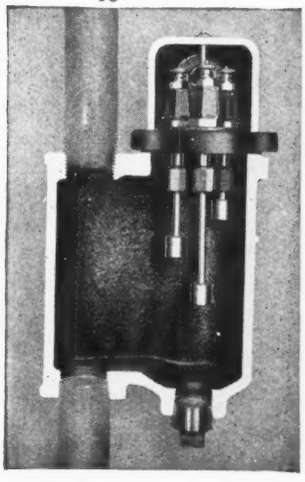

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SMOKE DETECTOR—Worner device is photo-cell arrangement previously described, for detecting smoke in air conditioning ducts, etc. Relays operate dampers, valves, which can be interconnected for fire protection. *Worner Products Co, 1019 W Lake St, Chicago, Ill.*

FIREBRICK—Ironton "Cavalier" is intermediate-heat-duty brick, said to give successful service in hand-fired boilers, brick kilns, annealing ovens, wasteheat installations and others. Has high salvage value because of its strength. *Ironton Fire Brick Co, Ironton, Ohio.*

CARRYOVER ALARM—Solu-Bridge controller gives automatic warning of presence of excessive carryover in boiler condensate. Both analytical and control functions performed by same instrument, and percentage of carryover present is read directly off dial on instrument front. *Industrial Instruments, Inc, Jersey City, N. J.*

STOKER MANIFOLD—Air-injection manifold is designed for small and medium-size steam plants where modernization of existing furnaces is desired. Low-pressure manifold has ability to spread small sizes of coal in predetermined pattern. Said to eliminate need for high-speed moving mechanical parts within high-temperature portion of furnace. *American Coal Burner Co, 155 E Superior St, Chicago, Ill.*

CYLINDER-BOILER WELD—Lusco cylinder-boiler weld designed to effect permanent repair of cracks and leaks in boilers, engine blocks and circulating systems. Concentrated "Weldium", synthetic metallic substance is deposited on fissure-edge until it has grown together in the center. *C F Lusk Co, 6523 Euclid Ave, Cleveland, Ohio.*

REFRACTORY—Adahearth is plastic chrome ore refractory for constructing monolithic hearths. Is chemically neutral refractory compounded into plastic consistency, and is made with South African chromite as base material. Can be used for forming protective coating on inclined bridge walls. *Botfield Refractories Co, Swanson and Clymer St, Philadelphia, Pa.*

SEALING COMPOUND—Fenox boiler casing sealing compound has been developed for use in sealing joints in boiler casings against air leakage. Compound is non-burning and non-hardening, remaining plastic over long periods of time. Easily applied with knife or spatula, will not flow even at elevated temperatures. *Bakelite Corp, 30 E 42nd St, New York, N. Y.*

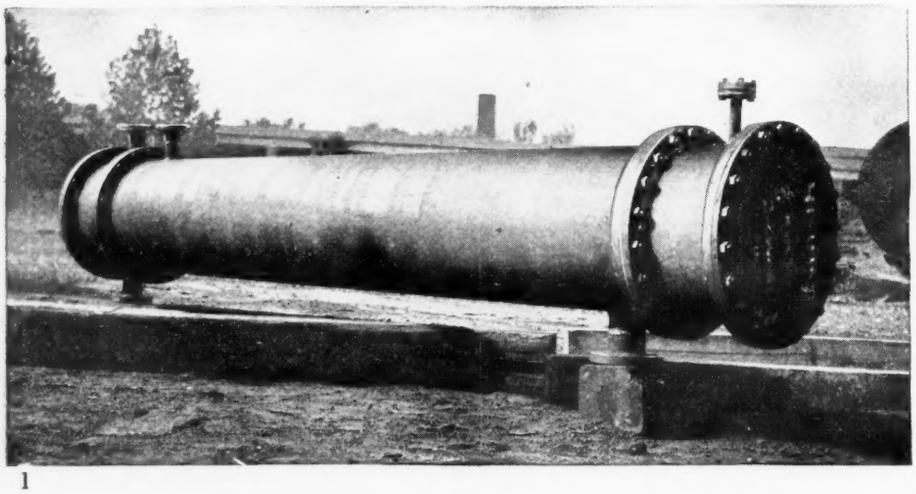
INSULATING CEMENT—Improvement in B-H 1 insulating cement comprises an addition of a rust inhibitor to the formula. This is said to prevent any corrosion taking place between the metallic surface and the cement, which ordinarily occurs when cements mixed with water are used. Cement is effective up to 1800 F and when used on equipment that operates at temperatures no higher than 1200 F it is fully reclaimable. *Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.*

1 HEAT EXCHANGERS—Company enters field with heat exchangers and water heaters built in separate company division. Line consists of shell and tube exchangers, horizontal or vertical types. Units have straight and U-tubes with channels and fixed and removable bundles. Type E storage water heater consists of tank of steel or non-corrosive alloy with removable U-tube heating element, for process use. Line also includes shell-and-coil heat exchangers. *Heat Transfer Div, Downingtown Iron Works, Downingtown Pa.*

2 CONDENSATE RETURN—Adaptable to any conditions in plants operating up to 250 lb, single system automatically returns condensate and supplies makeup water to boilers when actuated by mercoid switch at the water column. Makeup water is admitted to certified ASME receiver tank by float-operated valve when condensate reaches a predetermined low level or is insufficient to supply the needs of the boiler. *W M Acker Organization, Inc, Cleveland, Ohio.*

3 COMBUSTION CONTROL — Combustion control has integral governor which regulates fuel supply to the burner in direct relation to steam pressure. Diaphragm operated fuel-supply valve is electrically piloted and acts to maintain a constant steam pressure at all times by throttling gas flow and air damper in direct proportion. Valve has low-fire adjustment which sets minimum amount of fuel supplied to the burner. *General Controls Co, Glendale, Calif.*

4 ALARM SYSTEM — Flame-failure alarm system operates on photo-cell principle. Light from flame is directed on cell, resulting in small current flow through same. Through relay contacts, main fuel valve is energized. If light is shut off due to flame failure, reverse process occurs and fuel valve closes. *Brown*



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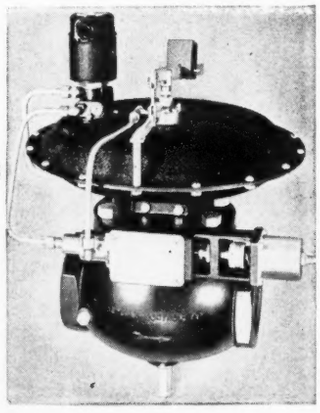

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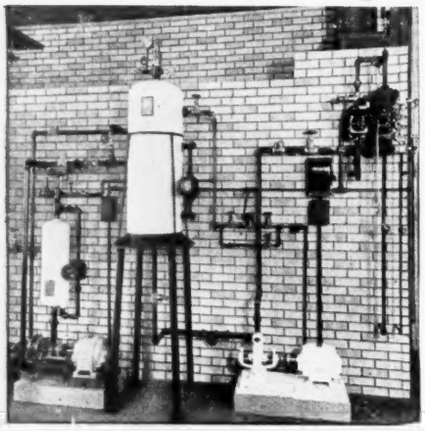

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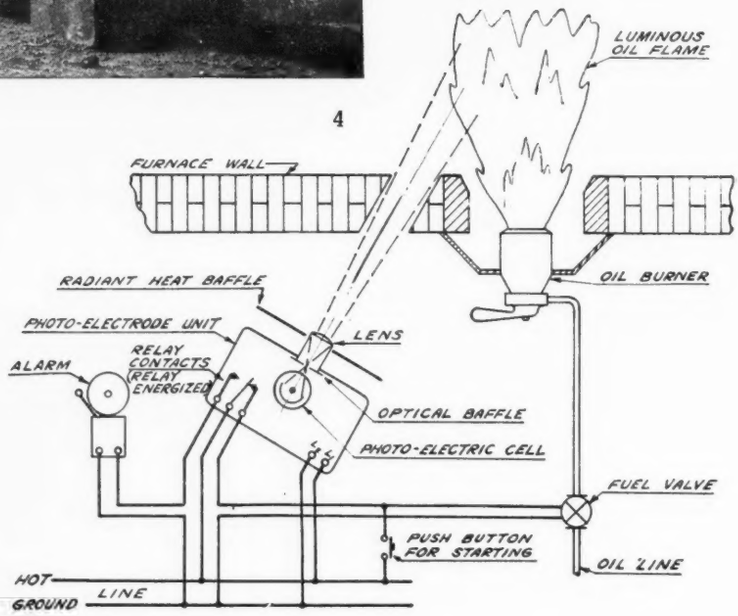

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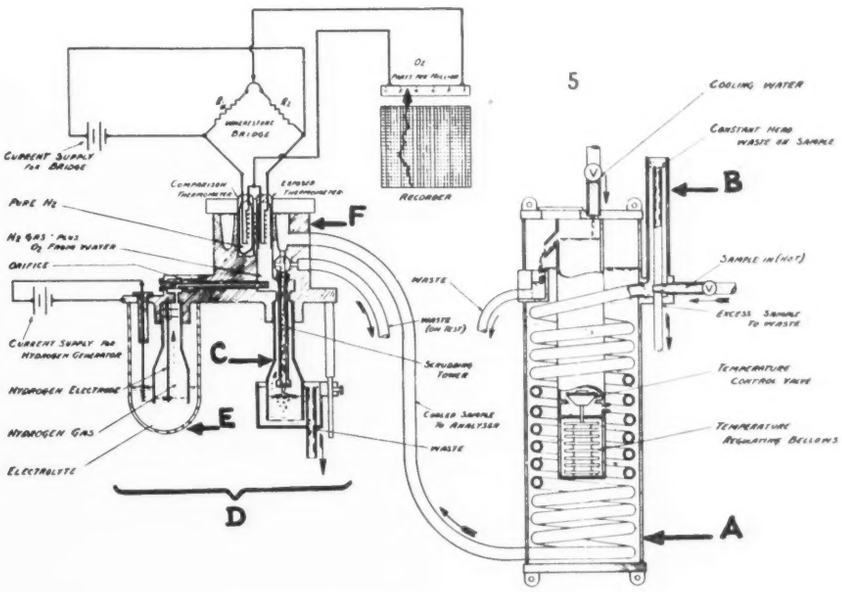
Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.

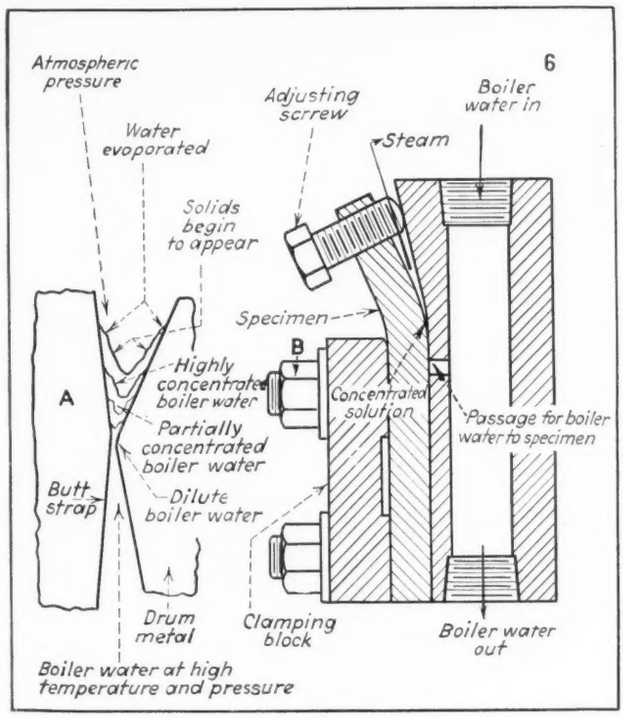
FEEDER CONTROL—Mosher control regulates mechanical feeding of stokers, pulverizing machinery, etc. Consists of controlling unit mounted in steel case, which connects to magnetic contactor switch of motor which is operating machinery. Control operates from 110 volt, 60 cycle line. (See photo below.) *Max Mosher, 130 W 42nd St, New York, N. Y.*

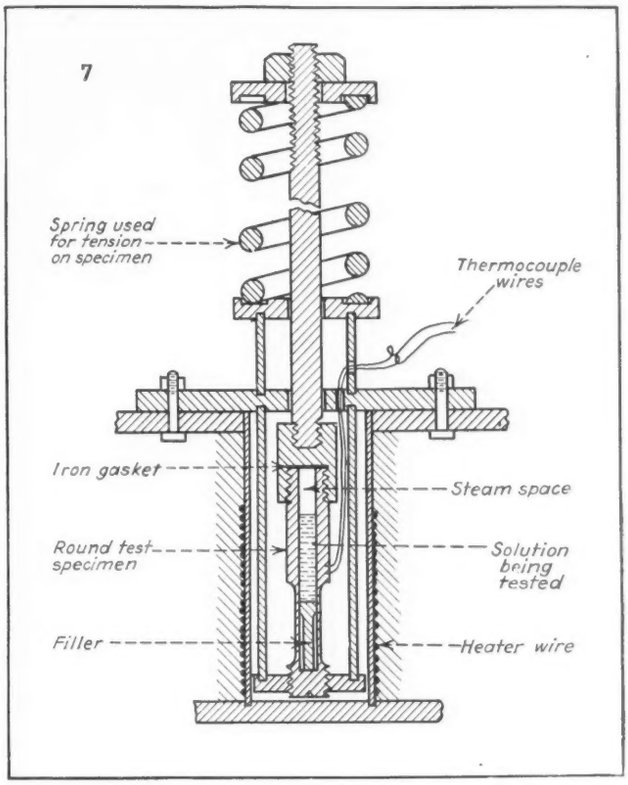
5 DISSOLVED OXYGEN RECORDER—Automatic recorder provides continuous indication and record of dissolved oxygen entering the boiler. As shown in diagram, water to be analyzed enters cooler-regulator *A*, where it is reduced in temperature and maintained at approximately 85 F. Constant-head device *B* maintains correct flow of water through the scrubbing tower *C* of analyzer unit, *D*. Hydrogen is generated in electrolytic cell *E* and flows to scrubbing tower where it comes into intimate contact with sample water. Water dissolves some hydrogen and gives up part of its oxygen. Resultant mixtures of gases diffuses to meter block *F* which contains the sensitive elements. Deflection of recorder is proportional to dissolved oxygen concentration in sample water passing through scrubbing tower. *Cambridge Instrument Co, 3732 Grand Central Terminal, New York, N. Y.*

6 EMBRITTLEMENT DETECTOR—For field testing of the embrittling qualities of boiler water, apparatus (Schroeder) is connected in the continuous blowdown piping. A feather of steam is allowed to escape from a small hole between the fitting and a steel specimen clamped tightly to it and stressed by an adjusting screw. By attaching this apparatus to an operating boiler, actual boiler water is concentrated in the capillary space and all conditions favorable to embrittlement are reproduced. Cracking of the specimen indicates that the boiler water could produce embrittlement if all other conditions were favorable in the boiler drum. *Hall Laboratories, Pittsburgh, Pa.*

7 EMBRITTLEMENT DETECTOR—For laboratory testing of embrittling qualities of boiler water, a spring-loaded device (Straub) shows fracture of the test specimen usually within 24-hr. About 7 cc of boiler water suspected of embrittling qualities is placed in a bored-steel specimen containing a filler piece having only a few thousandths clearance to simulate boiler concentrating conditions. Specimen is stressed to 40,000 psi and heated to the proper temperature in an electric furnace. Device is intended only for use in the laboratory. Operators suspecting boiler water of embrittling tendencies send sample to laboratory for check. These tests are part of an investigation conducted under a cooperative agreement between the Utilities Research Commission, Inc, Chicago, Ill., and the Engineering Experiment Station, University of Illinois.







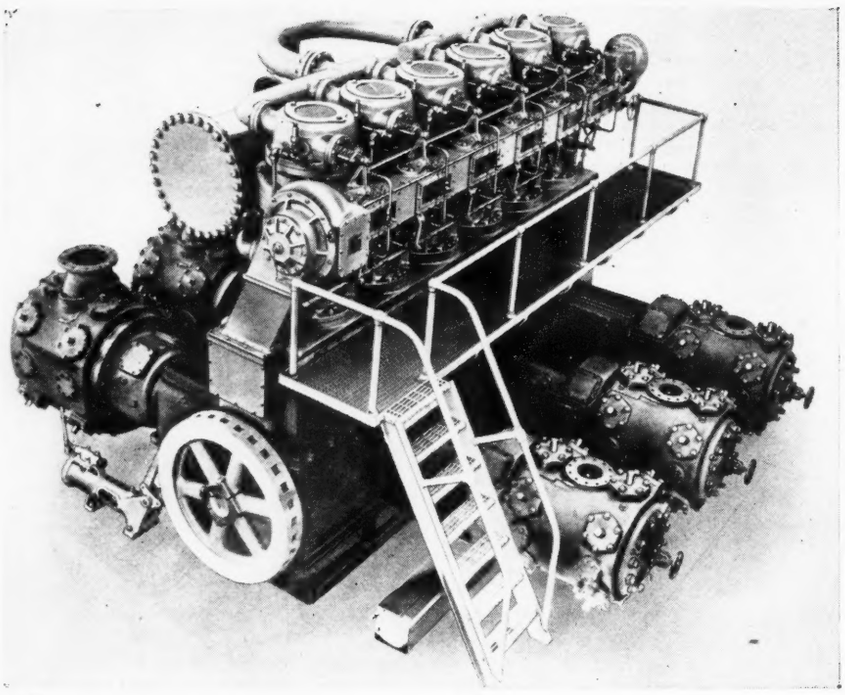
COMPRESSORS

1 STEAM-DRIVEN COMPRESSOR — Clark compressors for industrial, chemical and petroleum use furnished in capacities from 600 to 4000 hp. Machines have three to six power cylinders and corresponding number of compressor cylinders. Construction based on right-angle design of company's gas-engine-driven units. *Clark Bros, Olean, N. Y.*

2 STATIONARY COMPRESSOR — Package-type compressor available with built-in motor, belt wheel or coupling. Has double-acting crosshead construction, with no thrust against cylinder walls. Cylinders set at 90 deg angle, with reciprocating parts designed for lightness and strength. One-piece frame, with integral crankcase, is cast iron. Completely enclosed with oil-tight and dust-proof cover plates that give ready access to interior. Each frame neck provided with stuffing box fitted with double metallic wiper rings which prevent oil being carried along piston rods. When furnished with built-in motor drive, motor stator is bolted directly to a mounting flange on compressor frame. *Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.*

3 COMPRESSORS—"Eclipse" compressors designed to give larger capacities in less space and with less weight than older types. Either one, two or more cylinders can be equipped with automatic oil-operated unloading device which gives control of machine capacity in steps or as a unit. Standard equipment includes V-belt wheel, motor pulley and V-belts, oil-pressure gage, valves, and others. Automatic unloading device is optional equipment available at extra cost. *Frick Co, Waynesboro, Pa.*

AIR HOSE—Lightweight air hose so flexible that ½-in. size can be bent to 3-in. radius without collapsing tube or cutting off air supply. Tube is of oil-resistant rubber, with excellent heat-resisting characteristics. Two-braid hose can withstand working pressures from 80 to 125 lb. *B F Goodrich Co, Akron Ohio.*



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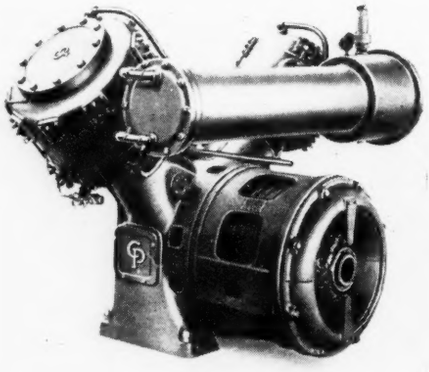

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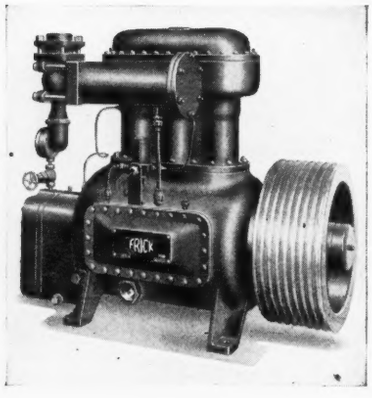

DIESELS, GAS ENGINES AND ACCESSORIES

3-CYLINDER DIESEL—Sheppard unit is 4-cycle, 3 cyl full diesel engine. Rated at 25 hp at 1200 rpm for continuous full load with fuel consumption rating under these conditions not to exceed .50 lb per bhp hr. Complete power unit includes all equipment necessary for full operation where fuel is available. Engine fitted with power take-off and clutch, radiator, fan and thermostat to protect cooling system. *R H Sheppard Co, Hanover, Pa.*

1 GAS ENGINES—Three models of heavy-duty natural-gas engines built with 2, 4, and 6 cylinders. Lubrication system provides efficient filtering and fuel pressure lubrication to all working engine parts. Combination gasoline-gas carburetor is standard equipment, and although engine will burn gasoline satisfactorily for short periods of time, such as starting periods, fuel system is set for most efficient combustion of natural gas. Models develop 34, 48 and 74 hp respectively. *Caterpillar Tractor Co, Peoria, Ill.*

2 DIESEL ENGINES — Stover engines, equipped with Lanova combustion chambers, available in four sizes with variety of mountings. Illustration shows standard stationary mounting. Models of 7½ and 10 hp are single-cylinder, while 15- and 20-hp models are twin-cylinder type. *Stover Mfg & Engine Co, Freeport, Ill.*

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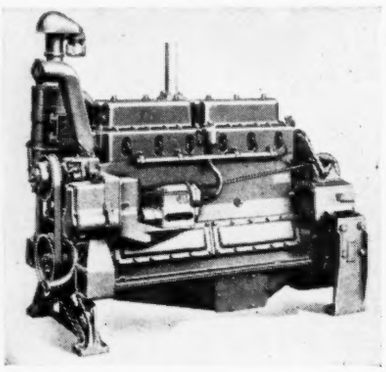

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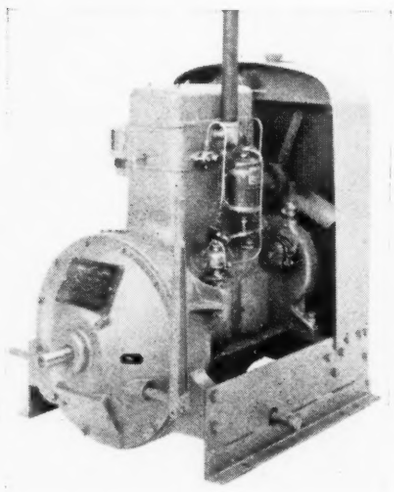


3 MAGNETIC FILTER—Frantz "FerroFilter" now made with permanent magnet, as addition to line made with electromagnet. Consists of stack of magnetic screens or filters, see illustration, mounted on tube, held in by permanent magnet on each side. Filter edges comb and recomb oil, magnetic particles being held firmly until cleaned. *S G Frantz Co, 161 Grand St, New York, N. Y.*

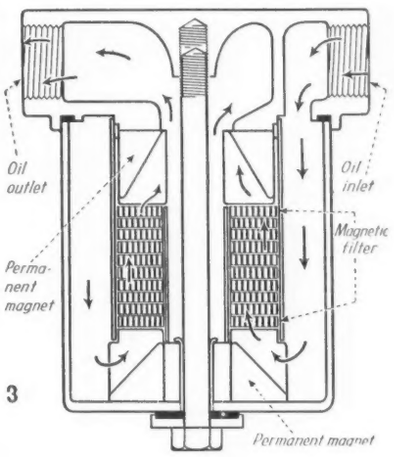
4 RING COMPRESSOR — Wilco ring compressor is maintenance tool for diesel operator. Used when replacing pistons, unit compresses piston rings so that piston can be inserted into cylinder bore. Crimps in lower edge make it impossible for tool to slide down inside cylinder. *Wilkening Mfg Co, Philadelphia, Pa.*

5 DIESEL INDICATOR—Kiene diesel indicator provides means of checking maximum and compression pressures in less than half usual time, maker says. Consists of cylindrical pressure chamber (1) attached to finned cylindrical body (2) by thread (3). To latter is attached indicator cock wing nut (4). Body is drilled through and tapped, and short stainless-steel stud is used to attach indicator cock plug to body, while upper part of tapped hole contains threaded brass filler (5). Above this is copper screen (6). Upper part of body is recessed to receive seat piece and center valve guide (8). This in turn centers valve (9) and limits its motion by means of stop screw (10), which is locked by nut (11). Gage is attached to bolt (12), secured by nut (13). Bolt and nut are fitted into body of pressure chamber by tapered ground joints. *Kiene Diesel Accessories, 3836 Fremont St, Chicago, Ill.*

6 DIESEL PYROMETER—Bristol pyrometers equipped with high-resistance millivoltmeter movements having automatic cold-end compensators. Units are highly damped to withstand excessive vibration. Thermocouple switches are rotary, with double contacts of phosphorous bronze. *Bristol Co, Waterbury, Conn.*

7 EVAPORATIVE COOLER — Diesel engine jacket-water coolers consist essentially of coil through which jacket water passes, nozzles to spray water on coil, and blower to force air past coils. Jacket-water heat is absorbed by air through direct transfer and by evaporation of water on coil surface. Spray water is constantly recirculated so that active amount consumed is only about 2 lb per 1000 btu of engine heat absorbed. *Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.*

8 DIESEL ENGINE — Improved Nordberg 2-cycle diesel gives more power in less space, maker says. Single, positive-displacement blower, gear-driven from crankshaft, supplies scavenging air in larger models, while reciprocating pumps are used on smaller jobs. All models may be equipped for burning natural gas, and change-over from oil to gas can be done without change of major parts and without departing from diesel cycle. Photo shows 7-cyl, 3000 hp, mechanical-injection unit. *Nordberg Mfg Co, Milwaukee, Wis.*



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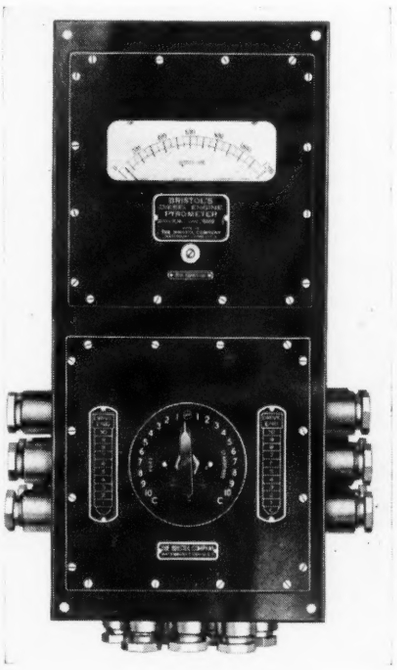

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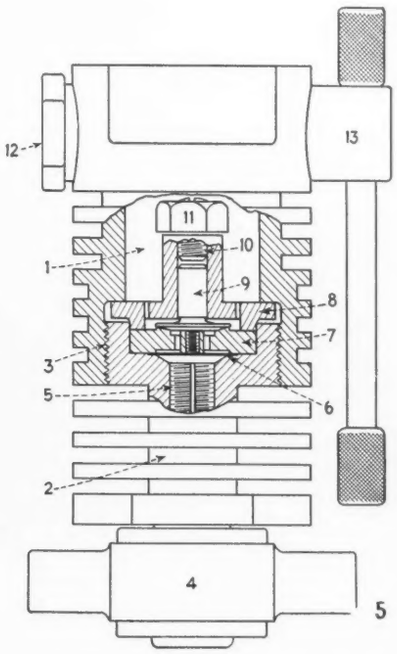

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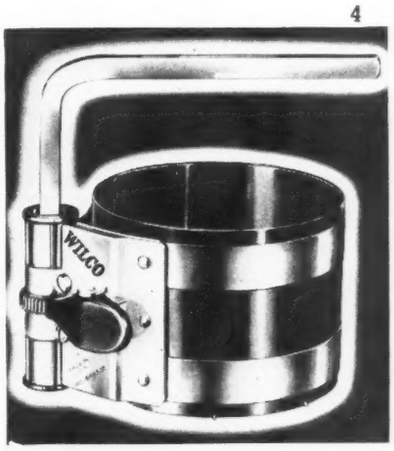

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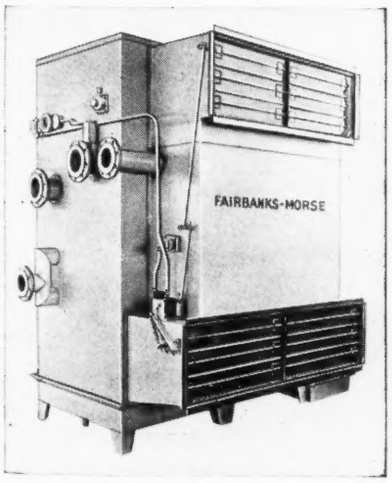

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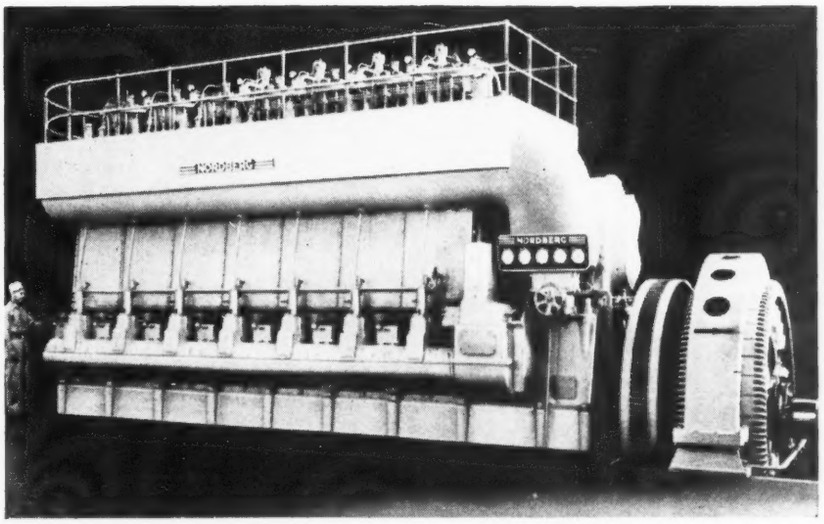

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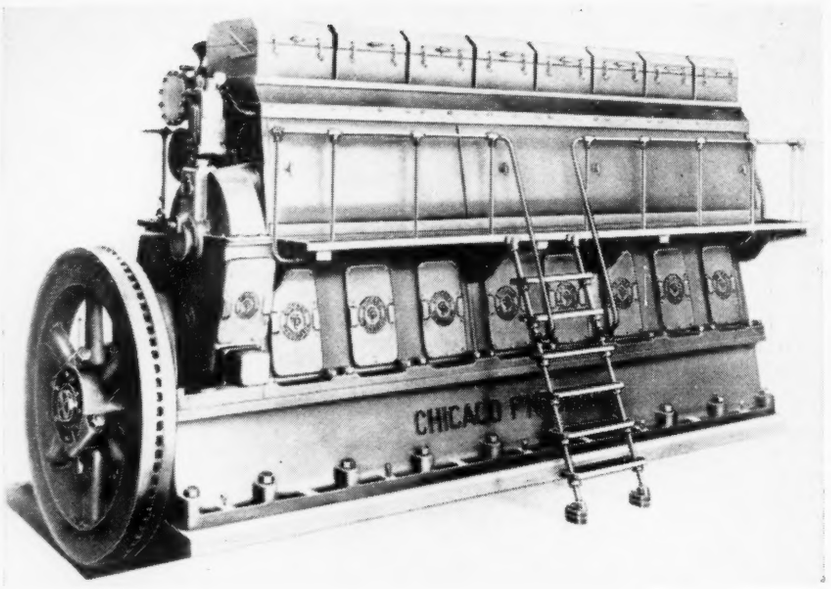
DIESEL ENGINE—Type 16 CP diesel is 4-cycle, direct-injection-type, designed for continuous duty. Available with from 3 to 8 cylinders, from 375 to 1000 hp. Cylinder heads are of nickel iron removable without disturbing manifolds, and intake and exhaust valves are carried in valve cages. All parts easily accessible. (Photo at right). *Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.*

INSULATORS—Vibro-insulators, mountings of rubber and metal to isolate vibration, now announced in three additional models. Type 44 is for use with gas burners, Type 50 specially engineered to isolate internal combustion engines against torsional vibration, and Type 60 for isolating vibration and noise of intake and exhaust fans. *B F Goodrich Co, Akron, Ohio.*

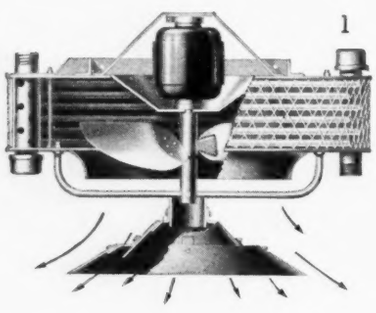
ISOCHRONOUS GOVERNOR—Governor has automatic reversing valve in pump oil lines and may be operated in either direction of rotation. Connection between throttle and governor may be made in same manner as when using plain centrifugal governor. Power piston of governor is provided with limit stops in both directions. Complete technical description can be found in company bulletin 3200. *Pickering Governor Co, Portland, Conn.*



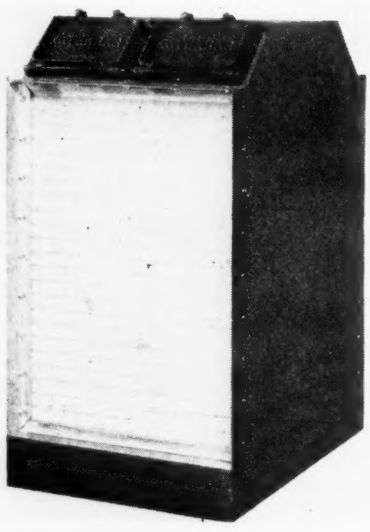
HEATING, VENTILATING, REFRIGERATION AND AIR CONDITIONING

1 UNIT HEATER — Downblast speed heater supplements company line of floor and standard suspended heaters. Where comparatively low installation is desired, deflection cones, illustrated, are left on unit, resulting in wider diffusion of heated air stream and temperature in working level. For high installations, cones can be removed easily to obtain greater downward velocity of heated air. Heater fins are aluminum for maximum heat transfer. Headers have threaded connections at both ends, allowing steam lines to be connected to whichever side is most convenient. *B F Sturtevant Co, 47 Readville St, Hyde Park, Boston, Mass.*

HUMIDIFYING UNIT — Kathabar system consists of two major parts: humidifying or dehumidifying unit and Kathene cleansing, reclaiming and recirculating unit. First unit is placed on roof or conveniently located near air intake. Single units or batteries provide quantity of air required. Regenerating unit is placed in remote part of building, and connected to humidifying unit by pipes. Kathene liquid is non-explosive, non-inflammable humidifying and dehumidifying agent that circulates through the pipes from contactors or cells to regenerator. In contactors or cells the Kathene forms a sheet-like wash through which incoming air must pass. Humidification or dehumidification is governed by temperature of Kathene. The wash also serves to cleanse the air, remove foreign odor, and the chemical action renders certain bacteria inert. Kathene then returns to the regenerator, where dirt and foreign particles are removed, moisture added or absorbed to bring liquid to its proper strength, and is again recirculated. (Photo directly below). *Surface Combustion Corp, Toledo, Ohio.*



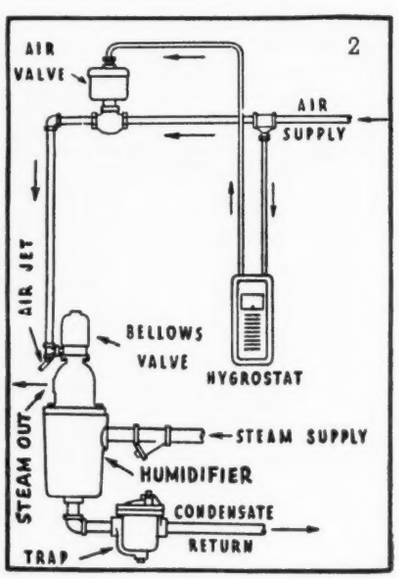
2 AIR-OPERATED HUMIDIFIER — Air-operated steam-type humidifier is intended for installations where electrical circuits are undesirable. As shown by diagram, assembly includes pneumatic hygrostat which acts as pilot valve to admit pressure to diaphragm chamber of main air valve when relative humidity drops below desired percentage. Opening main valve allows compressed air to flow to humidifier when pressure builds up and opens steam valve in top of humidifier. This admits steam to special silencing chamber, from which it escapes directly to atmosphere, adding humidity to room. *Armstrong Machine Works, 812 Maple St, Three Rivers, Mich.*



3 STRAINER—Strainer for use with spray nozzle when foreign matter interferes with efficient operation is equipped with ¼-in. pipe connection for inlet and outlet. Standard stock construction is brass with Monel strainer, although other material and sizes can be supplied. *Spraying Systems Co, 4021-S W Lake St, Chicago, Ill.*

4 BLOWER FAN — Backward and forward-curved blades featured in line of blower fans for heating, cooling and ventilating applications. Housings are convertible for various standard directions of discharge, while capacities range from 295 to 4500 cfm. *Trane Co, La Crosse, Wis.*

5 HUMIDIFYING NOZZLE — Illustration shows humidifying nozzle, which is placed with others in ceiling where water is maintained slightly below nozzle level by float-controlled tank. Compressed air is controlled by solenoid-



operated valve actuated by humidistat. If for any reason air is shut off, water will go back to controlled level. *Spraying Systems Co, 4021-S W Lake St, Chicago, Ill.*

6 INSULATION — "Koldboard" recently added to rockwool insulation line made by company. Consists of insulating block with mineral base, for low-temperature work. Maker says material will not distintegrate, suffer structural breakdown or decay. *Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.*

7 UNIT HEATERS — Vertical projection-type heaters are addition to line previously made. Units have all-copper and bronze heating elements, with few brazed joints. Copper fins are metallically bonded to copper tubes with permanent bond that maintains contact at high temperature. *D J Murray Mfg Co, Wausau, Wis.*

8 HEATERS — Falcon line of electric immersion type heaters used for maintaining and increasing temperatures of a wide range of materials. Consist of spirally coiled heater strips arranged to form compact unit, installed in sealed tank built in pipe line between storage vessel and saturating tank. Temperature is maintained uniformly by means of automatic controls, either thermostat, or pyrometer with thermocouple. *H O Swoboda, Inc, 13th St, New Brighton, Pa.*

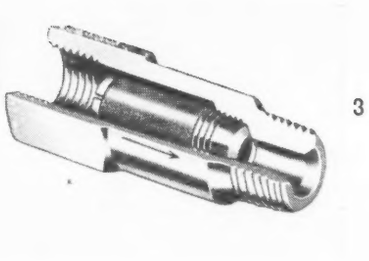
9 CONDENSERS — "Grid" condensers can be installed in window spaces or walls, without taking up floor space. Heating sections are easy to keep clean, as unit has no tortuous air-steam passages to get clogged. Units guaranteed for 250 lb steam pressure, continuous operation. *D J Murray, Wausau, Wis.*

10 ELECTRIC UNIT HEATER—Fan-type all-electric unit heater available in 2-, 3-, and 4-kw sizes at 115 and 230 volts, ac, and have outputs of 7000, 10,000 and 14,000 Btu per hr respectively. Fan operates independently for summer use, and baffles direct flow of incoming air over motor to protect it from radiant heat. *Westinghouse Elect & Mfg Co, East Pittsburgh, Pa.*

11 TEMPERATURE CONTROLS — Newest control in line is direct-acting thermostatic control for tank and process applications to regulate steam or water flow. Its function is to provide modulating flow of water, steam or gas and to control temperature within 1½ deg F, plus or minus. Standard low-pressure control is tight-closing, single-seated and semi-balanced, with corrosion-resistant bronze valve and seat. High-pressure control is of same design with stainless-steel valve disk, seat and stem. Standard thermal bulb is constructed of copper for immersion in non-corrosive liquids. *Sterling Inc, 3732 N Holton St, Milwaukee, Wis.*

HEATING SURFACE—Extra-length heating surface provided with steam distributing tubes. Extra-length sections are made possible by means of assuring uniformity of distribution from which surface derives both its resistance to freezing and special control characteristics. Two elements combined in single casing provided with separate steam and return headers, yet interconnected so that only one main steam and return connection are necessary. *John J Nesbitt, Inc, Philadelphia, Pa.*

SPRAY NOZZLE—"Parasol" atomizing spray nozzle is hollow-cone type, with uniform distribution and wide spray angle. Nozzles have machined and polished insert and are of sturdy construction. Capacities range from 4 to 16 gals per hr at 16 lb per sq in. *Spraying Systems Co, 4021-S W Lake St, Chicago, Ill.*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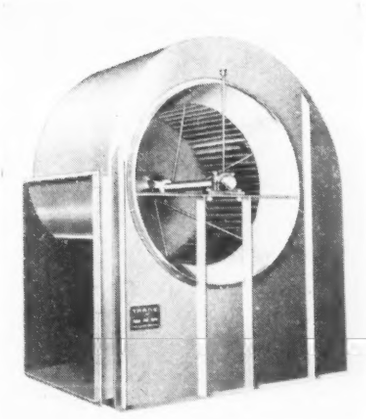
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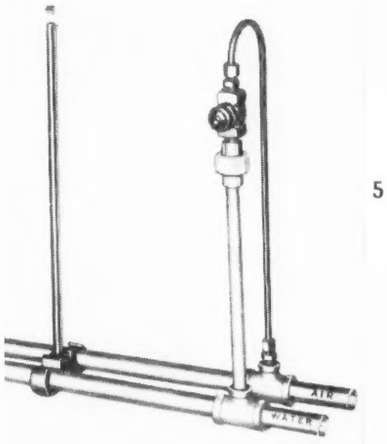

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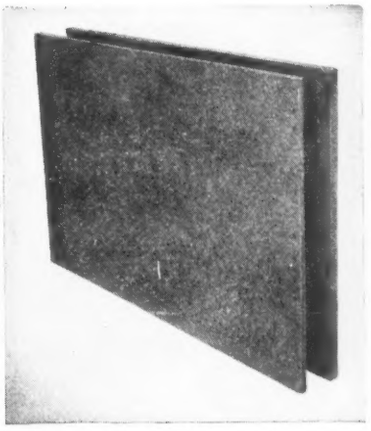
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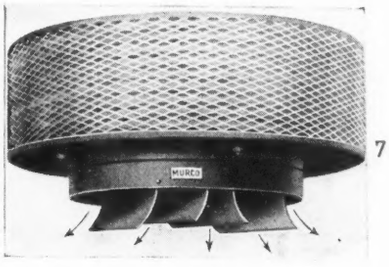

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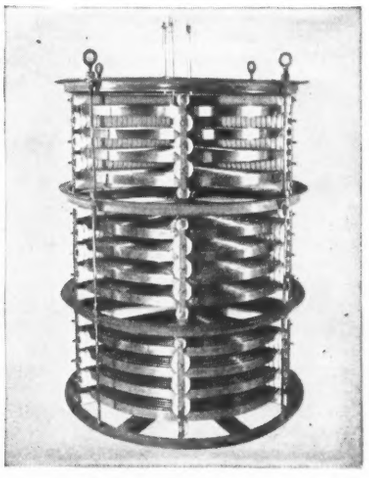
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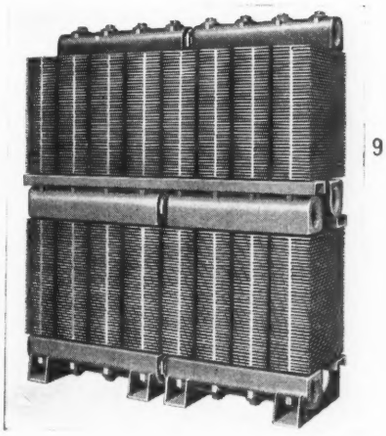
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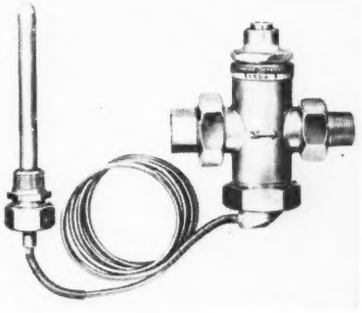
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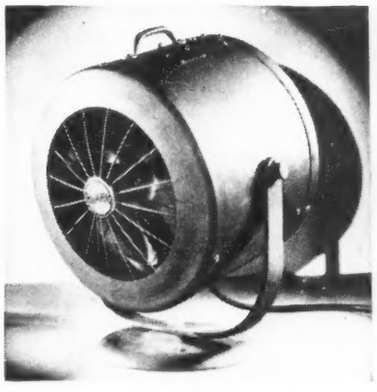
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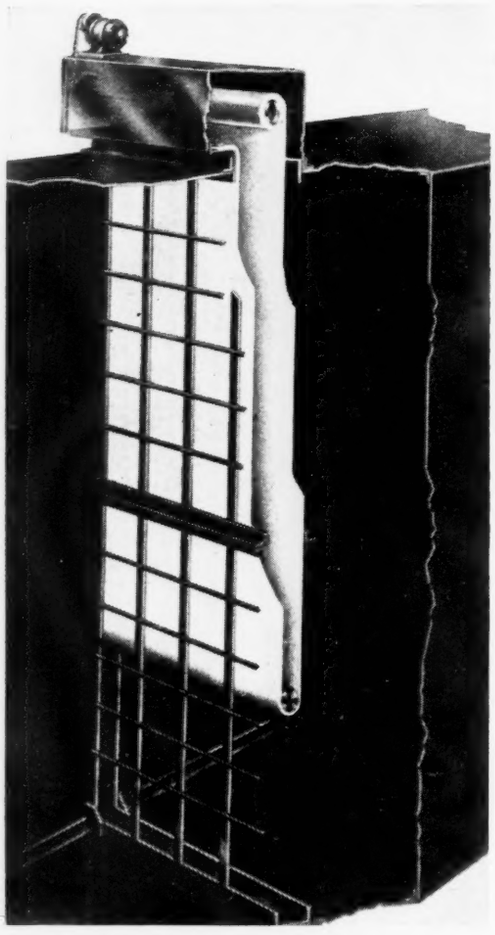

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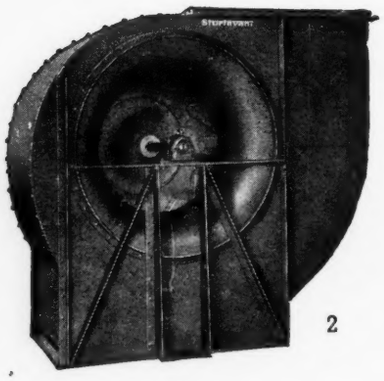

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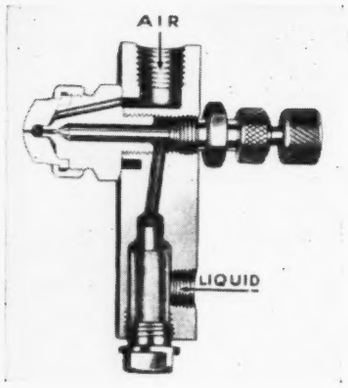

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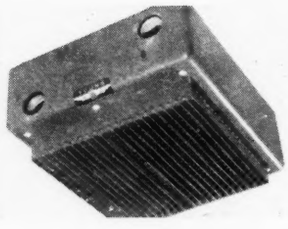

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1 DAMPER—Heacon damper consists of flexible asbestos curtain held in place against sealing strips in duct by draft, automatically producing tight seal. Damper adaptable to boilers up to 300,000 lb per hr. All gas must pass under damper, as compared to conventional dampers that leak on four sides. *Heacon, Inc, Luzerne & Second Sts, Philadelphia, Pa.*

2 FAN—Silentvane Design 8 operates quietly and has low outlet velocity. Housings are of steel plate with rolled-bead joints reinforced with heavy bracing angles. Designed for 9000 fpm maximum tip speed, in accordance with NAFM standards, for Class I fans. *B F Sturtevant Co, 47 Readville St, Hyde Park, Boston, Mass.*

3 ATOMIZING NOZZLE—Illustration shows pneumatic atomizing nozzle for chemical, industrial processes and humidifying. Nozzle available with internally mixed round or flat spray, with fluid shut-off needle optional. Strainer is removable. *Spraying Systems Co, 4021-S W Lake St, Chicago, Ill.*

4 UNIT HEATER—Gas-fired unit heater has adjustable louvres, control system and thermostatic control with sequence starting and complete safety control. Solenoid gas valve can remain open only if pilot is ignited and fan operating. *McQuay, Inc, 1628 Broadway, N E, Minneapolis, Minn.*

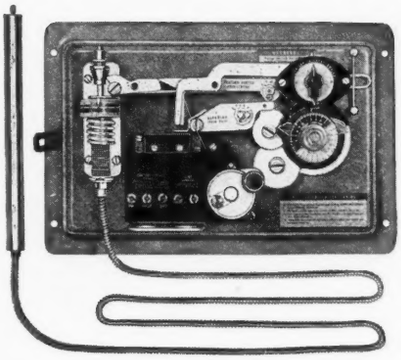
5 WATER HEATER — All-steel version of company's copper-tube heater is designed to supplement, not replace, the latter. Used to heat water and other liquids with steam and can be hooked directly to high-pressure steam lines without reducing valves. Unit will withstand steam pressures as high as 150 lb in standard types, and as high as 250 lb in special heavy-duty types. *Johnson Corp, Three Rivers, Mich.*

6 UNIT HEATER—Vertiflow unit heater has Young heating element equipped with 1-piece cast-iron headers into which special cast-iron tubes are expanded, rolled and ferruled. Casing is formed with round corners from heavy-gage sheet steel. All types provided with mounting holes tapped for hanger rods on each corner of heater. Any type diffuser selected can be easily fastened to casing bottom. *Young Radiator Co, Racine, Wis.*

ELECTRIC HEAT ELEMENTS—"Black Heat" is process by which electric filaments of subglow temperature are interwoven with spun glass and other insulating materials for wall board heating, etc. Wall board manufacturers said to be working with such elements for warming walls of rooms, and experiments also being conducted for casting heat elements in copper sheets or placing it between two sheets of metal for lining walls and heating installations where space is at a premium. *Heat Elements, Inc, Buffalo, N. Y.*

HEAT LAMP—Infra-red heat lamp announced as first commercial type of radiant unit whose design and construction makes possible full control of heating efficiency. "Bullseye" lamp set to control spilled heat rays outside the control of any reflector and put them to work for heating, even when present reflector equipment is utilized. New bulb is distinguished by a ring lining of silver sealed inside of the bulb at a point just below the focal point of the filament, as illustrated. This silver ring leaves a clear spot through which heat beams are projected from the filament direct to the heating area without spill or loss. All remaining heat rays, including those formerly spilled, are now gathered into control area by the ring lining and projected down to the heating area. Special feature is mechanical strap-in base made heat proof to keep the base from loosening under extreme heat developed in infra-red installations. Unit will be available in 250 watt size, Tungstun filament only, will fit the standard Edison screw socket, and will have an average burning life of excess of 5000 hours. (See photo below). *Wabash Appliance Corp, 335 Carroll St, Brooklyn, N. Y.*

HEAT CIRCULATOR—RECO heat circulator is high-powered fan which is hung near ceiling. In operation, fan takes hot air which rises to ceiling and dissipates it over the room or plant, then recirculates it back to the ceiling. Provides, according to maker, even distribution of heat, and substantial reduction in fuel costs. *Reynolds Electric Co, Chicago, Ill.*



HEATING REGULATOR—Model 7 Tritrol regulator (left) offers in one compact instrument all various controls and switches necessary for complete automatic heat regulation based on outside temperature. Included in regulator are built-in features such as "hold-fire" switch, automatic cutoff when outside temperature rises above 65 F, and special 4-position switch which adds flexibility to system. *Marsh Tritrol Co, 600 S Michigan Ave, Chicago, Ill.*

HEAT REQUIREMENT CALCULATOR—5-in. diameter circular (right) with revolving dial acts as calculator. By setting dial to any outside temperature it shows corresponding degree days, proper time to start heating, correct time to shut off, etc. Also shows excess capacity of plant. *Marsh Tritrol Co, 600 S Michigan Ave, Chicago, Ill.*

HOSE, PACKING AND PAINTS

PACKING—Asbestos packing has been designed for elevated temperatures. Known as Palmetto Cab Cock packing, it is braided from long-fibre Canadian asbestos yarn, bottom cut. Packing contains no liquid lubricant which might be boiled away. Intended for pumps and valves handling high-temperature steam, oil or gas. Can also be used for expansion joints and other applications. *Greene, Tweed & Co, Bronx Blvd at 238th St, New York, N. Y.*

PATCHING COMPOUND — Floor-patch is cementitious material for patching floors. Adaptable to quick, overnight repairs, and floors may be used for light traffic next morning. Maker claims material sets harder than concrete. *Truscon Labs, Detroit, Mich.*

DUPLEX TUBING—Tubing is constructed with one type metal on outside and inner tubing of different metal. Application example: in oil-refinery work, tubing with steel outside for corrosive oil vapors and copper inside for circulating fresh water. Many combinations of metal possible, according to maker. *Bridgeport Brass Co, Bridgeport, Conn.*

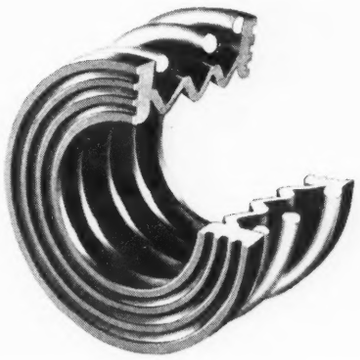
GASKETS—Ameripol, synthetic rubber, is proving satisfactory material, maker says, for various forms of gaskets and rings assembled with machines to keep oil or grease confined in bearings. *B F Goodrich Co, Akron, Ohio.*

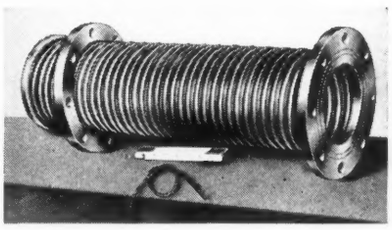
PLASTIC COMPOUND—"Insulmat" has been developed to eliminate condensate drip from air ducts, etc. It is spray-on plastic compound, containing specially treated cork particles. Compound is self-bonding, requires no priming coat, adhesive or supports, and can be applied to any metal surface. *J W Mortell Co, Kankakee, Ill.*

WATERPROOFING COMPOUND — Hydrozo is liquid-type waterproofing compound for masonry. Maker claims material can be applied to finest types of masonry without changing its appearance and will penetrate pores of masonry to a depth of from one- to three-fourths of an inch. *Hydrozo Products Co, 2725 Kendall Ave, Madison, Wis.*

PACKING—Non-staining packing available for handling liquids that must be kept untainted or uncontaminated. Klero is snow-white in color, and has odorless, tasteless, edible and chemically resistant lubricant. Braid-over-braid construction said to prevent accumulation of solid materials in packing. *Greene, Tweed & Co, Bronx Blvd at 238th St, New York, N. Y.*

PLASTIC PACKING—Super-seal packing is dry-graphitized plastic packing made from long-fibre asbestos, anti-frictional metal particles and special binders. Recommended for centrifugal and rotary services such as centrifugal pumps, rotary pumps, expansion joints. *Crane Packing Co, 1800 Cuyler Ave, Chicago, Ill.*





COMPOUND—Petroseal is compound made to fill need for oil-resisting electrical caulking material for transformer and oil-switch bushings and covers. Said to adhere readily to any clean, dust-free surface, yet can be easily removed and salvaged. *Johns-Manville, 22 East 40th St, New York, N. Y.*

SPIRAL PACKING—Palmetto high-pressure spiral packing is made of closely woven asbestos cloth with center block laid up against flat strip of heat-resisting, resilient red rubber. Packing is spiraled on mandrel and vulcanized, then exclusive lubricating process is carried out. *Greene, Tweed & Co, Bronx Blvd at 238th St, New York, N. Y.*

METAL HOSE—Seamless metal hose has double-thread helical corrugations. Unit shown represents anti-vibration tube of 6-in. ID, 7¾-in. OD, 30 in. long. Rigid brass companion flange is brazed on one end; other end has floating flange for proper adjustment to existing equipment. Any length and any type end connection can be furnished. Company's smallest size hose shown in comparison in center photo. *Seamlex Co, Inc, 5-19 48th Ave, Long Island City, N. Y.*

WATERPROOFING COMPOUND — Primoid standard is one of four compounds, said to be effective seals for concrete, brick, stone, and other types of masonry as well as for wood and composition materials. Also said to be adaptable for use in coating iron, steel, and other metals, preventing corrosion, and resisting oils, brine, acids, etc. *Primoid Products Co, 103 Park Ave, New York, N. Y.*

PUMP SEAL—(Top photo)—Seal has only two parts; bellows and spring. Entire unit is spring driven and operates as driving coupling. Seal does not touch or have a sliding contact with the shaft. Serrated contact facings are responsible for positive seal at both washer and driving base points. Bellows connects two flanged ends. Spring is placed in fixed position against the inside shoulders of the flanged ends, and so holds the contact facings against the sealing washer on one end and the driving base on the other. *Crane Packing Co, 1800 Cuyler Ave, Chicago, Ill.*

PAINTS—Five new paints designed to replace scarce aluminum paints. Consist of Valdura tank white, Valdura metal lead, two Valdura defense grays and Valdura enamelized yellow metal primer. For both new construction and maintenance applications, paints may be applied by brushing or spraying. *American-Marietta Co, 43 E Ohio St, Chicago, Ill.*

LUBRICATING EQUIPMENT

1 OIL FILTER—Purolator duplex filtering unit designed for places where installation requires large filtering space in small area. Large area attained by using two elements in each unit in parallel, one metal element inside a larger one in telescopic fashion. Control valve cuts one off line for cleaning, without affecting other. *Purolator Products, Inc, Newark, N. J.*

2 SIGHT-FEED LUBRICATOR—Unit for air-driven equipment operates successfully regardless of position on line, according to maker. Does this because of absence of baffles. Requires single regulating valve, as against three for other types. Oil is added by removing simple screw plug at lubricator top. *Roto Co, 145 Sussex Ave, Newark, N. J.*

3 DUST-PROOF OILER—Trico oiler has removable filter that can be extracted for cleaning without special tools. Oiler is mounted on top of unit to be lubricated and any predetermined number of drops of oil per minute can be obtained by needle-valve adjustment. *Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee, Wis.*

4 AUTOMATIC LUBRICATOR—Ace lubricator is filled by grease gun and feeds lubricant automatically. Said to eliminate over- or underfilling, shows when refilling is necessary, is self-contained and can be taken apart quickly for cleaning. *Ace Lubricating Equipment Co, 2345 W Grand Blvd, Detroit, Mich.*

5 LUBRICATION UNITS—Self-contained lubricating systems have all pipes, pumps, lubricators, etc, in one unit, and sole requirement for putting units in operation is connection of piping and wiring. Models available from 2 to 25 gpm. Electric gong, pressure gages and switches, valve-control system and mill-stand assembly furnished as standard equipment on all models. *S F Bowser & Co, 1302 E Creighton Ave, Ft. Wayne, Ind.*

ENGINE LUBRICANT — Essolube HD has been developed to overcome piston varnishing, ring sticking and other lubrication troubles which have limited output of many high-speed diesel and gasoline engines. Said to have, in addition to other qualities, high ability to wash out sludge deposits, to protect bearings from corrosion, and substantially to prevent deposits of varnish on pistons, valve stems, rings, and other engine parts. Lubricant has passed General Motors test and has been approved by Caterpillar Tractor Co for use in its diesels. *Standard Oil Co of N. J., 26 Broadway, New York, N. Y.*

LUBRICATING OIL — Savamotor "All Season" motor oil is manufactured in all SAE grades for internal-combustion engines, stationary, automotive, or in airplanes. Specifications of a given sample as follows: viscosity index 100+; gravity less M, 28; microphites by weight, 1%; flash 430 F, viscosity at 210 F, 67 sec; carbon 39%; cold test 0 F. Claims made include: 5000 miles between changes, with normal oil level; no motor damage starting cold with any SAE rating of oil, and others. *Sava Co, 140 Liberty St, New York, N. Y.*

LUBRICATING OIL — "HPO" oil developed after intensive laboratory and field tests, and announced as company observed diamond jubilee, 75 years after introduction of first mineral lubricating oil for steam engines. To lubricate, clean and seal modern high-speed engines effectively, two factors were combined in new lubricant: high viscosity index (105-110), highest of any heavy-duty oil on market, and effective detergent action. In this Pennsylvania oil, detergent acts with oil as soap does with water. It keeps undesirable oxidation particles circulating within oil and prevents them from depositing on engine. Detergent action results in "dirtier" oil, according to maker, but does not cut down lubricating qualities. *Valvoline Oil Co, 5th & Butler Sts, Cincinnati, Ohio.*

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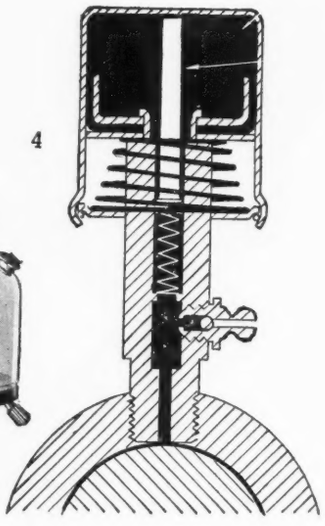

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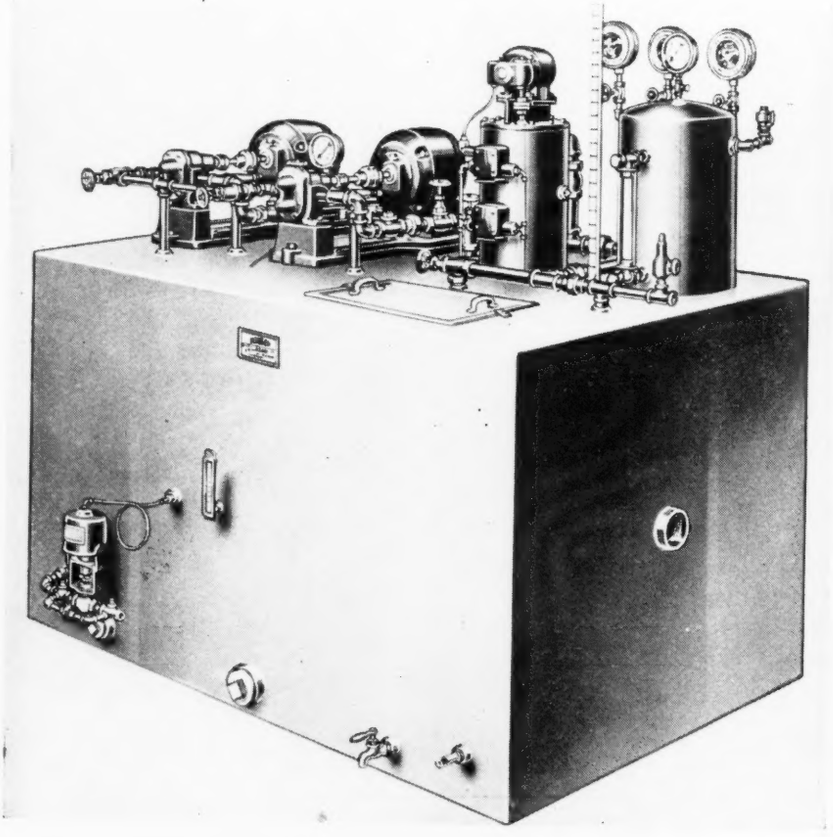

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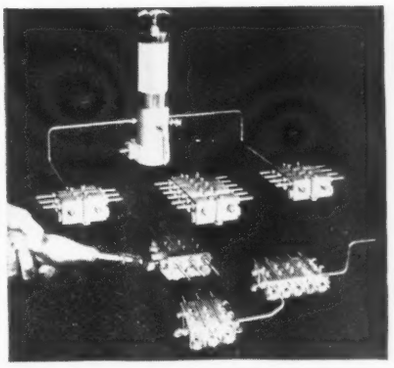
FORCED-FEED LUBRICATOR — Non-reversing, single-pipe, centralized forced-feed lubrication system consists of a bank of three or more sections, each of which discharges a known and measured quantity of lubricant alternately through one or two discharge outlets connected to bearings. Capacity or volume of different section of same distributor may vary from .005 to .035 cu in. Illustration at right shows a 6-outlet distributor operated manually with a pressure gun; a 6-outlet distributor led from another distributor; and a 6-outlet, 12-outlet and 18-outlet distributor connected to a Series "MP" variable-feed multi-outlet pump. *Trabon Engrg Corp, Cleveland, Ohio.*

LUBRICATION SYSTEM—Alemite progressive lubricating system delivers predetermined quantity of lubricant to a range of three to 20 bearings, and when job is completed, signals operator. Has four major improvements designed expressly for large-scale lubrication: (1) All bearings in one piece of equipment can be lubricated simultaneously from one point, (2) inaccessible or dangerously located bearings are conveniently lubricated at will, (3) lubrication of complete machinery is speeded, and (4) machines may be lubricated while operating. On equipment involving larger number of bearings, lubrication systems can be used in relays, each system or relay lubricating a maximum of twenty bearings. Any type of manually or power-operated high-pressure grease gun can be used with this system. *Alemite Div, Stewart-Warner Corp, 1826 Diversey Parkway, Chicago, Ill.*



MECHANICAL TRANSMISSION AND MATERIALS HANDLING

1 CRANE LIMIT STOP—Main-circuit crane limit stop prevents overtravel of crane hook when hoisting. Device is operated with counter-weighted lever and suspended reset weight, see cut. As hook approachs travel limit, reset weight is raised, allowing counterweight to trip switch. *Cutler-Hammer, Inc, Milwaukee, Wis.*

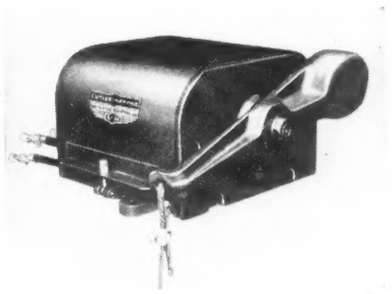
2 IMPACT IDLER—Troughing-type, rubber-tread idler made to absorb shock of receiving heavy, lumpy rough materials at loading point. Molded-rubber-tread rolls, 6-in. in diameter, are secured to roller-bearing-equipped tube, see illustration. Idlers available for belt widths of 14 to 60 in. Individual rolls can be replaced if necessary. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

3 PILLOW BLOCKS—Sleevoil precision pillow blocks in plain and water-cooled types designed for industrial applications, including fans, blowers, etc. Lubrication is provided by "T" section brass oiling rings. Oil gage provided which can be placed in either side of bearing, and by use of more pipe can be extended as desired. Units are identical in design and construction except for water-cooling feature. Sizes up to and including 3 15/16-in. are water cooled in lower liner only, and have one flexible inlet and one outlet connection. Sizes 4 7/16-in. and larger are water cooled in both upper and lower liners, and have 2 flexible inlet and outlet connections. *Dodge Mfg Corp, Mishawaka, Ind.*

4 FLEXIBLE COUPLING—L-R type HKQ is applicable to either horizontal or vertical drives, and is recommended for longer-distance drives. As illustration shows, floating shaft is supported in fixed bearings, independent of power-transmitting elementts, and does nothing but transmit useful power. *Lovejoy Flexible Coupling Co, W Lake St, Chicago, Ill.*

5 COAL SCALES—SECO coal scales have endless belts, specially molded with integral side flanges. In event of electrical failure, coal can be bypassed by merely raising lever. Lowering lever closes bypass, and lead seal gives definite indication that bypass has been used. *Stock Engrg Co, Cleveland, Ohio.*

6 VULCANIZER—Type RO patch vulcanizer is designed for repairing conveyor-belt covers. Unit is 10 in. in diameter, of single-heater platen type and clamps against a steel plate 12 in. in diameter, held against opposite sides of the belt. *B F Goodrich Co, Akron, Ohio.*



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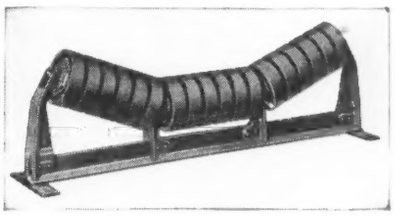

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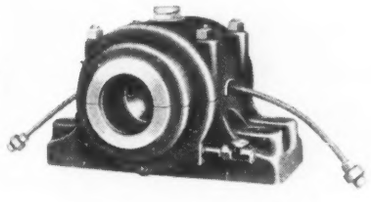

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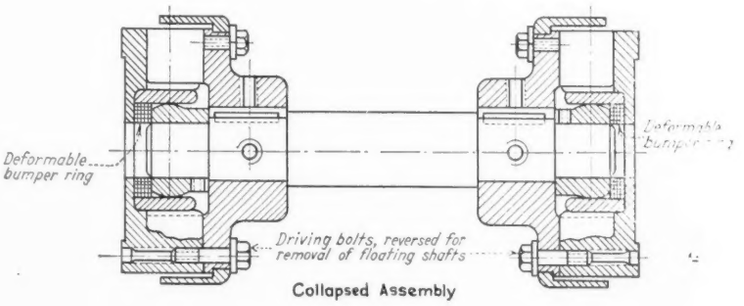

Collapsed Assembly

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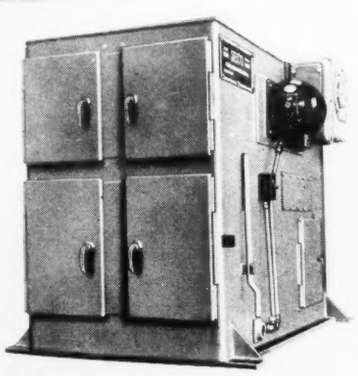

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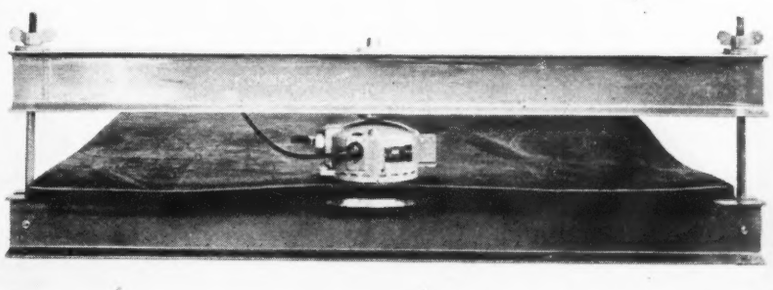

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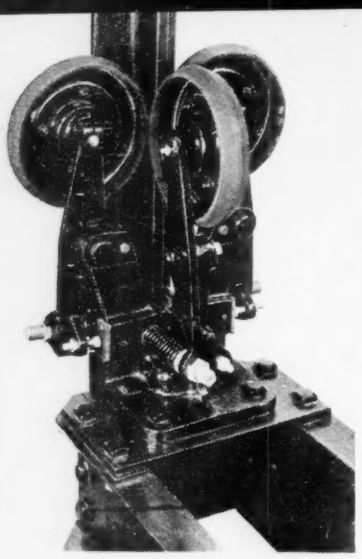

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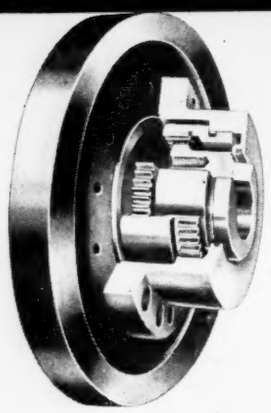

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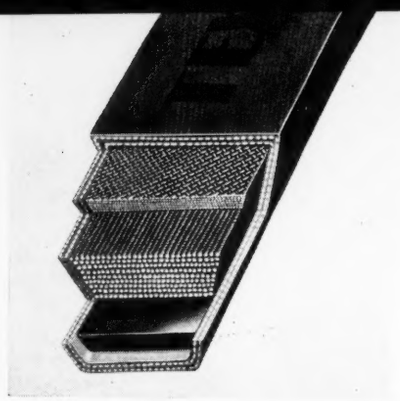

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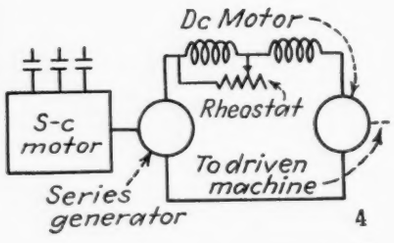

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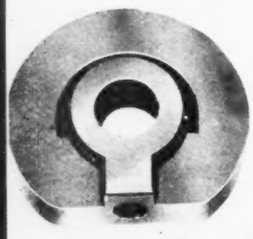

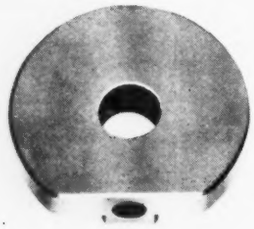

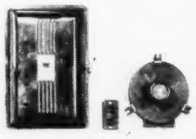

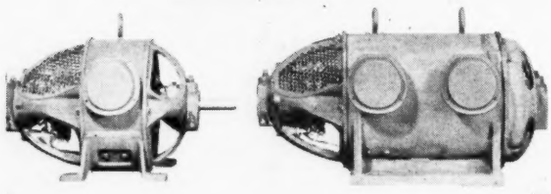

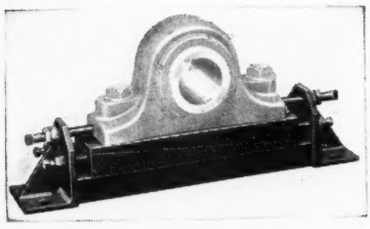

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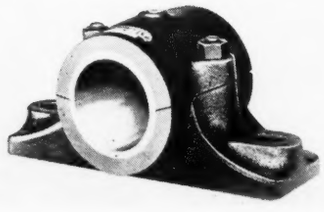

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1 ELEVATOR ROLLER GUIDES—With Otis roller guides, both elevator and its counterweight are guided by large, spring-cushioned, rubber-tired wheels, instead of sliding shoes. These wheels operate on dry rails, eliminating oil and grease from hoistways. *Otis Elevator Co, 260 11th Ave, New York, N. Y.*

2 BEARINGS—"Selflube" porous bearings made from powdered alloys, moulded to size in shape desired, then baked and finally quenched in oil. Units have tensile strength of over 35,000 lb psi, and have low friction coefficient. *Keystone Carbon Co, 1935 State St, St. Mary's, Pa.*

3 FLEXIBLE COUPLING—Manger coupling can be used to connect a shaft directly to a flywheel, brake drum or flange, and can be utilized for connecting two free-ended shafts in combination with solid flanged half-coupling. Can also be combined with magnetic- or pneumatic-clutch coupling. *Farrel-Birmingham Co, 344 Vulcan St, Buffalo, N. Y.*

4 & 5 ADJUSTABLE-SPEED AC MOTOR DRIVE—Adjustable-speed drive uses series circuit without usual exciter. New drive has five parts, see Figs. 4 and 5, including control. These are single-unit motor-generator set, consisting of squirrel-cage induction motor driving a series dc generator, which supplies operating voltage for a dc series motor coupled to driven load. In parallel with generator field is rheostat which controls driving-motor speed. Control apparatus consists of an across-the-line starter for squirrel-cage motor and pushbutton station. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

6 MULTIPLE V-BELT—"Super 7" laminated design now included in all Texrope belts made by company said to provide more strength, flexibility and longer life. Cords in new belt smaller, permitting use of more cords per belt, with resulting greater strength and less stretch. Each cord individually imbedded in heat-dissipating rubber to reduce internal belt degeneration. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

7 PORTABLE HOIST—"Pul-lift", 4½-ton capacity, has same safety and construction features as previous models. Addition to line brings models available from ¾ to 6 tons. Unit will operate in both horizontal and vertical position, and can thus be used for both pulling and lifting. Short easy strokes on lever at any point within complete circle permit operation in most cramped quarters. *Philadelphia Div, Yale & Towne Mfg Co, Philadelphia, Pa.*

8 MULTI V-BELTS—Company enters multiple V-belt field with line of standard sizes. Heavy elastic-fabric envelope takes up outside wear on belts, permits ready flexing and holds tightly to groove. *Cincinnati Rubber Mfg Co, Cincinnati, Ohio.*

9 BASE PLATES—Types A and B base plates are of welded steel, tabulated, for mounting pillow blocks of shaft sizes up to 8 in. Type B, illustrated, is for both horizontal and vertical adjustments. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

10 BEARING — Babbitted-bearing common flat box has maroon-colored crackle-finish housing. Sloping surfaces between cap and base maintain concentricity and relieve cap bolts of direct strain from side thrust. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

11 DETACHABLE SHEAVES—V-belt drive sheave eliminates, according to maker, necessity of wheel puller to remove wheel or hub from shaft to get at driving unit. To remove rim, all bolts are withdrawn and two are inserted in holes so tapped in rim that bolts act as jamb screws and bear against hub, forcing rim off taper without disturbing hub position. *Worthington Pump & Machinery Corp, Harrison, N. J.*

12 SPEED CONTROLS — Additional V-S units announced, with same principle of speed control as previous units. Only change has been in outward appearance. Unit has been mounted horizontally instead of vertically and mounting brackets have shock pads to insure quiet operation. *Reliance Electric & Engrg Co, Ivanhoe Rd, Cleveland, Ohio.*

13 PRE-CAST BEARING — Bronze-on-steel is essentially thin-wall laminated bearing that combines bearing qualities of high-grade bronze alloy with strength of steel. Borings obtained by drilling solid bar are reduced to powder, treated in hydrogen furnace and firmly bonded to strip steel. Also available as graphited bearing. *Johnson Bronze Co, 508 S Mill St, New Castle, Pa.*

14 & 15 CONVEYOR BELT—Turnable conveyor belt provides double thickness of cover over areas of greatest wear, on each side of belt, so that when abrasion wears down one side, belt can be turned over

and additional service obtained from other side, see illustrations 14 and 15. *B F Goodrich Co, 460 S Main St, Akron, Ohio*

16 BEARINGS—Inner-ring bearings, in fractional-inch dimensional bores, are for machine applications on straight shafts, and are equipped with patented Sealmaster centrifugal labyrinth seal, which keeps out dirt and retains lubricant. *Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.*

17 VARIABLE-SPEED TEST RIG — Fully-enclosed test rig combines basic PIV unit and adjustable mounting bracket on rigid welded-steel base. Can be used to test generators, governors, vibrators, pumps, etc, where tests are made to determine whether equipment runs true, or functions efficiently. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

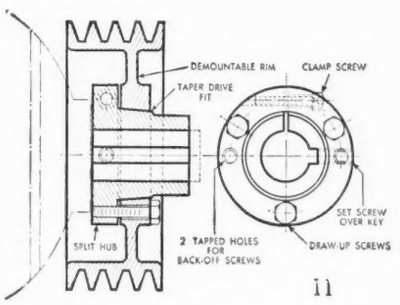
18 FLEXIBLE COUPLING—Airflex coupling is for connecting diesel, oil, gas or gasoline engines to any type of driven machinery. Consists of resilient rubber gland bonded to inner and outer steel rims. Gland is inflated to proper pressure through Schraeder valve. *The Falk Corp, Milwaukee, Wis.*

19 CHAIN COUPLING—Type D Ramsey flexible-chain coupling is constructed to eliminate completely shearing of pins in chain. New pinions, instead of having straight sides, are cut diagonally so that one pinion pulls other through chain, employing full tensional strength of chain's width. Wear of teeth due to excessive misalignment is distributed evenly across entire face of both pinions. *Ramsey Chain Co, Albany, N. Y.*

TRANSMISSION BELTING—"Octopus" belting provides greater grip and resilience, according to maker, obtained by combining 24-oz duck with special impregnating material. *Manheim Mfg & Belting Co, Manheim, Pa.*

BEARINGS—Improved line of solid and split-journal bearings have machined bases and faced ends. Both styles tapped for grease cups or pressure fittings. *Jeffrey Mfg Co, Columbus, Ohio*

FIBRE PULLEYS—New construction for small- and medium-sized rolls or pulleys provides tough rugged hub and spider of zinc alloy, stronger than iron, cast under high pressure



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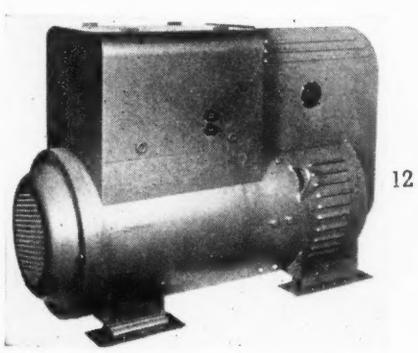
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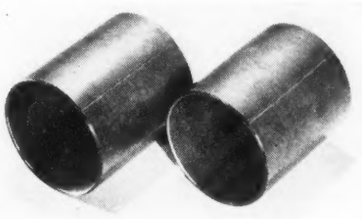
right in body of fibre. *Rockwood Mfg Co, Indianapolis, Ind.*

VIBRATING CONVEYOR—"Free-flow" vibrating conveyor and feeder operate on lift-throw principle with trough motion becoming increasingly horizontal with each cycle, thus imparting gentle forward motion to conveyed material. *Standard Transmission Equipment Co, 416 W 8th St, Los Angeles, Calif.*

CONVEYOR BELTING—Improved shock-absorber conveyor belting has specially compounded layer of soft cushioning rubber between comparatively stiff abrasion-resisting cover and hard fabric belt body. Excessive impact or shock is dissipated by this cushion. *Republic Rubber Div, Youngstown, Ohio*

CONVEYOR BELT—Homocord belt intended solely for conveyors and in present stage of development is not applicable to transmission belting. Belt uses new type of cord and new body construction invented for conveyor belts. *Manhattan Rubber Mfg Div, Passaic, N. J.*

BEARING MATERIAL—Carbobronze contains 91.2% copper, 8.5% tin, and 0.3% phosphorous and is made in tubular form from ½ to 3½ in. OD, within reasonable limits of wall thickness. *Revere Copper & Brass, Inc, 230 Park Ave, New York, N. Y.*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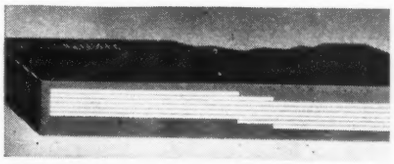
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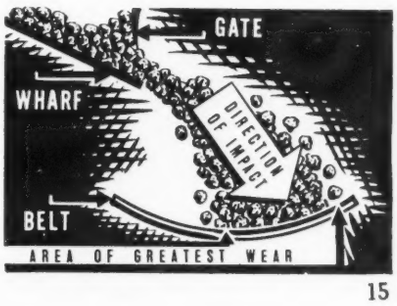

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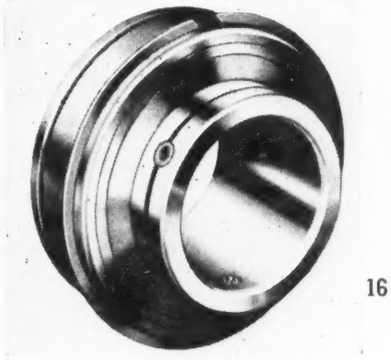
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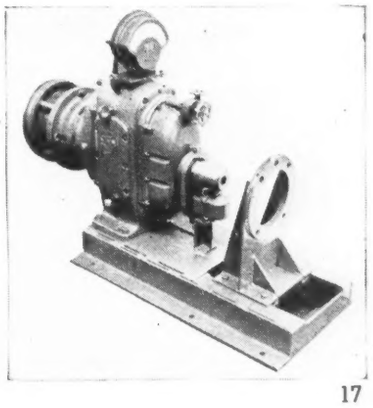
HIGH-SPEED BELT—Gilmer-Hevaloid belt is designed for high-speed precision work, according to maker. Non-slip surface results from direct contact of belt material with pulley face, giving high coefficient of friction. *L H Gilmer Co, Tacony, Philadelphia, Pa.*

PULLEY COATING—Nonslip "Rubberpull" has rubber base and is compounded so that it sticks to pulley regardless of pull exerted. Can be applied in a few minutes time, with pulleys ready for use the next morning. *Nonslip Pulley Covering Co, 777 Hertel Ave, Buffalo, N. Y.*

V-S PULLEY—Complete variable-speed unit includes variable-pitch pulley and adjustable sliding motor base. By turning base handwheel, motor moves backward or forward, causing increase or decrease in belt tension. *Ideal Commutator Dresser Co, Sycamore, Ill.*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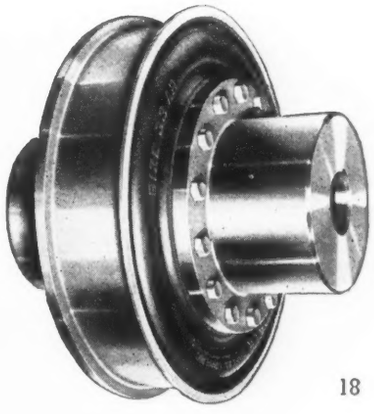
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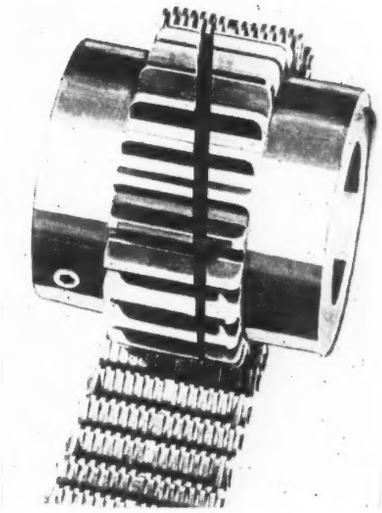
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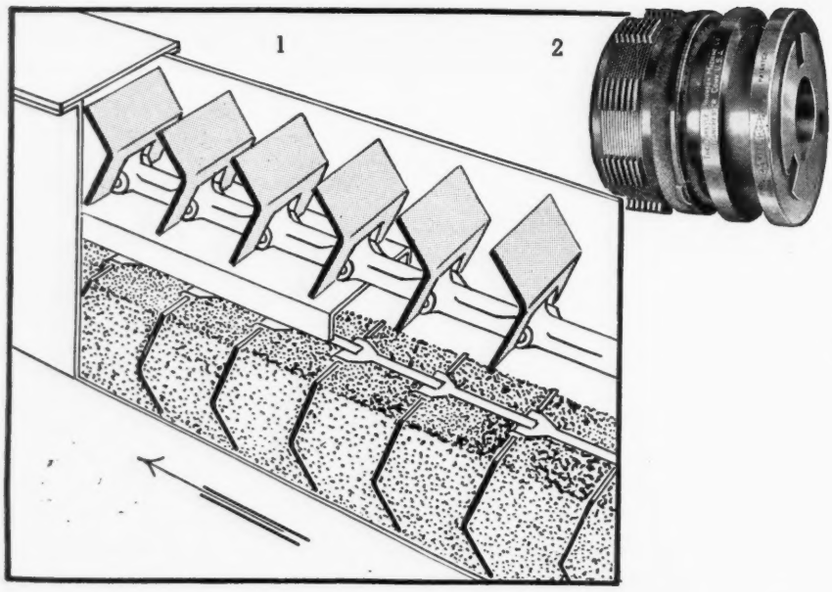

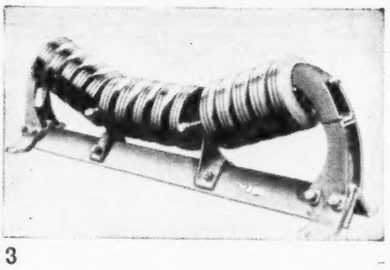

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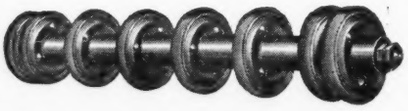

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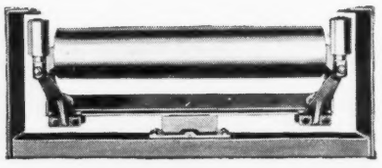

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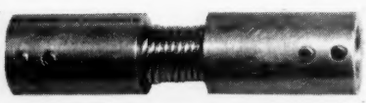

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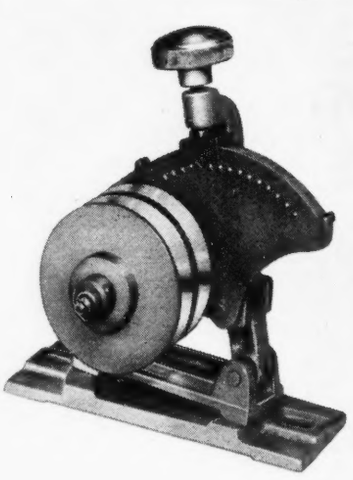

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1 BULK CONVEYING SYSTEM—Conveying medium employs specially designed chain, to which solid peak-top flights are attached at every pitch. These divide material in conveyor duct into continuous series of batches which are moved whether load is full or partial. *Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.*

2 FLOATING-PLATE CLUTCH — Maxitorq clutch has floating plates, resulting in a minimum of drag, abrasion or heating. In neutral, a separator spring between each pair of inner disks spreads the disks endwise, and a plate locks all disks against this spring tension. *Carlyle Johnson Machine Co, 52 Main St, Manchester, Conn.*

3 PNEUMATIC CARRIER—Carriers made up with series of pneumatic rubber units, similar to miniature automobile tires. Designed for use on belt conveyors where impact shocks are excessive. *Stephens-Adamson Mfg Co, Aurora, Ill.*

4 RETURN IDLER—Individual rolls in idler made up of extruded rubber tire clamped between two disks. Recommended for handling corrosive, wet or sticky materials. *Link-Belt Co, 307 N Michigan Ave, Chicago.*

5 BELT IDLER—Self-aligning belt idler has centrally pivoted cross member which has a vertically mounted actuating roll at each end for contacting belt edge when its lateral misalignment exceeds a predetermined amount. *Link-Belt Co, 307 N Michigan Ave, Chicago.*

6 FLEXIBLE COUPLING—Coupling uses 4-layer high-carbon Swedish piano wire flexible core which is fused by high pressure into metal butt ends with various size bores. Misalignment and angularity is governed by the length of core. *National Electric Mfg Co, 60 East 42nd St, New York, N. Y.*

7 TRANSMISSION—JFS-Cub is designed for all "A" section V-belt applications and for speed ranges up to 3.3–1. Uses smooth-sided pulleys rather than inter-locking type. Unit can be mounted in any position without throwing belts out of alignment. *Standard Transmission Equipment Co, Los Angeles, Calif.*

PULLEY COVER—Warren pulley cover is applied to pulleys and V-belt sheaves with brush. Compound dries quickly, giving an adhesive surface which is said to eliminate belt slippage, allow belts to run slack and easy. *Warren Pulley Cover Co, Danielson, Conn.*

V-BELTING—Open-end V-belting is for drives where endless V-belts cannot be used economically without dismantling a machine to get at sheaves. *B F Goodrich Co, 460 S Main St, Akron, Ohio*

PILOTED COUPLING—Steelflex coupling, constructed entirely of steel, consists of two hubs, one of which carries an integral flange, to which cover is secured, special tempered-steel member forming complete cylindrical grid member, and flanged steel cover secured to hub flange with cap screws. *Falk Corp, Milwaukee, Wis.*

METERS AND INSTRUMENTS

TEMPERATURE REGULATOR—Vapor line unit designed to control heating medium on degreasers. Feature is sensitive bulb or thermostat, formed of heavy-wall helically corrugated tubing, braced inside. Temperature adjustment is made by sliding bulb up down in bracket until position is found for vapor line in tank which maintains correct temperature. *Sarco Co, Inc, 183 Madison Ave, New York, N. Y.*

TEMPERATURE INDICATOR — Automatic indicator serves where large number of thermocouple temperature readings are to be taken. As many as 50 couples can be used with one instrument, and all are connected to model switches on indicator front. To read a couple's temperature operator simply throws switch and pointer moves automatically to correct scale position. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

TACHOMETER — Standco universal hand tachometer is direct-reading centrifugal type. Instrument has rotating gear shift in knurled cover for changing to five speed ranges, knife-edged pointers, large 3-in. dial and easy-to-read scales. *Herman H Sticht Co, 27 Park Place, New York, N. Y.*

DC RECORDERS—CF line of inkless recorders has been extended to include direct-current instruments, available as voltmeters, ammeters, millivoltmeters, milliammeters and microammeters in ratings down to 125 microamperes, full scale. *General Electric Co, Schenectady, N. Y.*

TRANSMITTING SYSTEM — "New-matic" system measures differences in temperatures, flows, levels, pressures, etc. Consists of two measuring elements equipped with pneumatic transmitters, each of which delivers air pressure proportional to the measured variable, and a differential pressure-detector employing a mercury-filled U-tube, together with a float actuating a recording or indicating pointer. *Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.*

1 ELECTRONIC LEVEL CONTROL — Photoswitch level control available for conductive and non-conductive fluids and powders. For 2-level control, electrodes are attached to tank at levels representing low point, where pumping starts, and high point, where pumping stops. Liquid level opens or closes relay to operate pump control circuit. *Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.*

2 FREQUENCY METER — Vibration frequency meter, weighing eight ounces, is designed to aid engineer in ferreting out causes and cures of machine vibration. Device built around vibrating-reed principle and consists of thin spring steel vibrator clamped at one end between set of rollers. Photo shows meter being used to determine frequency of vibration on small motor frame. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

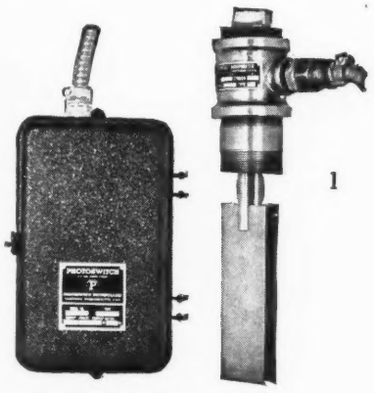
3 MULTI-POINT INDICATOR — Indicates drafts, pressures, differentials and other factors in boiler and furnace operation. All adjustments and piping connections are accessible from panel front, and all units can be withdrawn, like a book from a shelf, without disturbing others. *Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.*

4 FUEL-OIL METER—Fundamental operating principle of Vesta meter based on oil volume, rather than speed of oil flow. Fuel consumed is registered continuously by counter which runs to 9999 $\frac{9}{10}$ gals, then repeats. *Fluid Meters, Inc, 60 Wall Tower, New York, N. Y.*

5 TRANSPARENT THERMOMETER Precision thermometer operates through bimetal strip, *A*, which, when temperature rises, actuates to move pointer *B* around dial. Wooden piece *C*, is for attaching unit to window. *Precision Products Co, Waltham, Mass.*

6 OXYGEN RECORDER — Cambridge recorder produces continuous record of oxygen percentage in furnace atmospheres. In essentials, analysis cell consists of four identical fine platinum spirals in two cells contained in metal block. Spirals are heated by passing equal electric currents through them, and when both cells contain same gas, four spirals reach same temperature. If oxygen in gas in one cell is replaced by equal volume of CO_2, spirals in that cell will become hotter than the other, difference in temperature being proportional to CO_2-concentration increase in the cell. Gas stream is passed first through one cell, through furnace, and then to second cell. Furnace contains rod of hard carbon steel heated to combustion temperature so that, during its passage through furnace, any oxygen in gas is converted to CO_2. Change in concentration between two cells and current in galvanometer are proportional to oxygen concentration of original gas. *Cambridge Instrument Co, Inc, 3732 Grand Central Terminal, New York, N. Y.*

PH INDICATOR — Glass-electrode indicator retains full accuracy, according to maker, up to 185 F in atmospheres up to 95% relative



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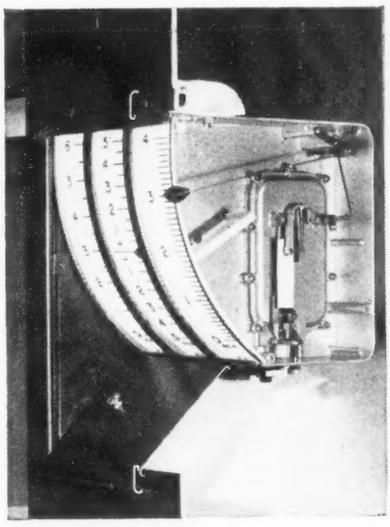
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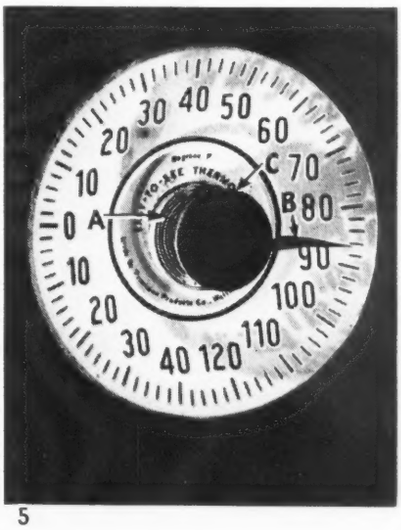

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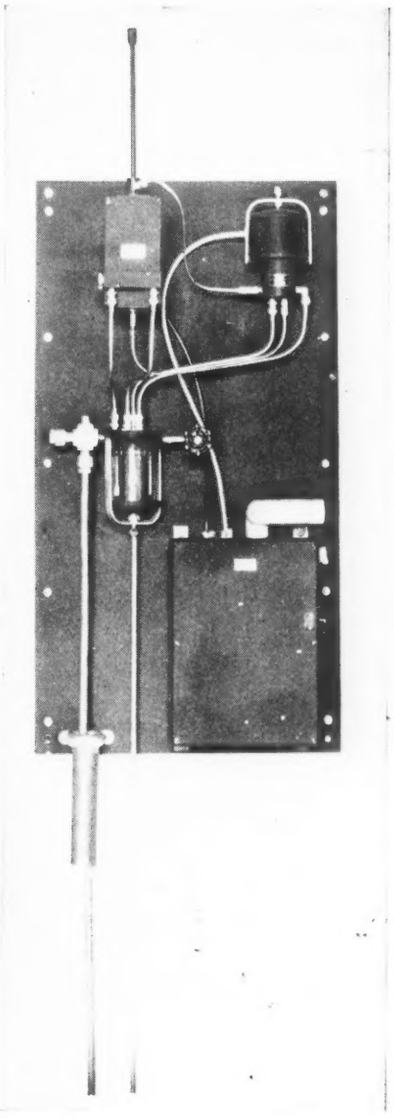
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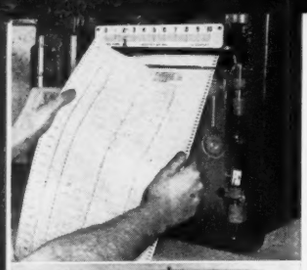

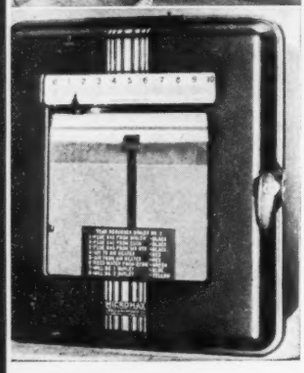

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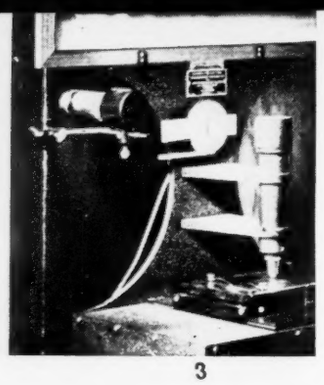

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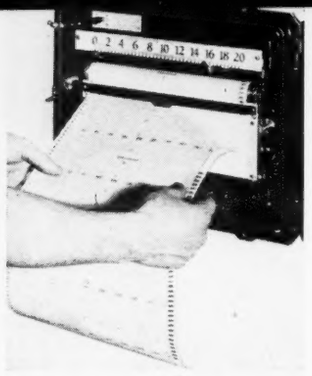

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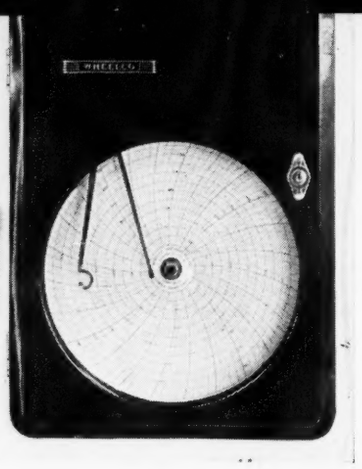

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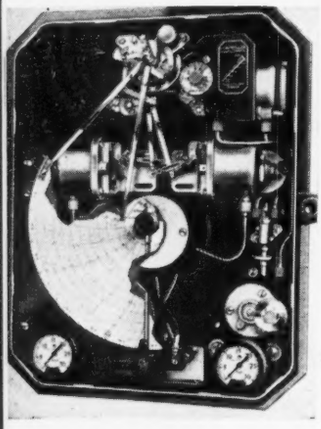

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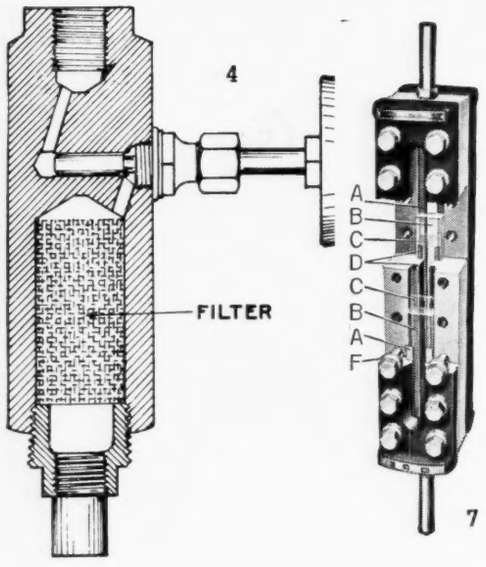

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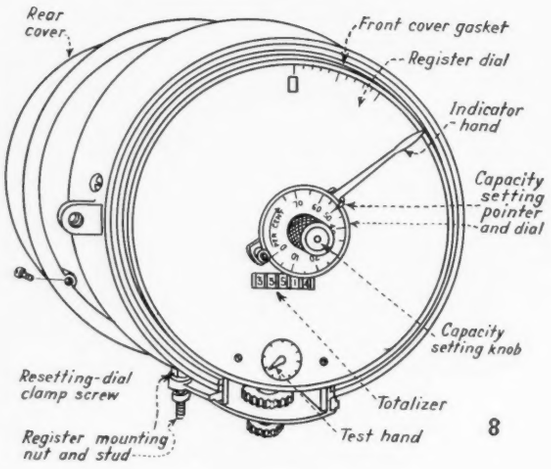

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humidity. Measurements can be made consistently within its limit of error of adjustment ± 0.1 pH. Measurements made by simply pouring sample into instrument's self-contained beaker, and reading pH directly from meter scale. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

1 TEAR-OFF DEVICE — Enables users of Micromax strip-chart recorders to tear off and file record of each day's operation. Device is made to fit Micromax recorders and can be attached quickly. Rubber stamp can be supplied which identifies recorder and location of thermocouples. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

2 RATIO CONTROLLER—Controller is for use where temperature, pressure, rate-of-flow or liquid level must be controlled in desired ratio or differential to another related variable. With new instrument, it is unnecessary to disturb processing or remove chart while making adjustment. *Taylor Instrument Co's, Rochester, N. Y.*

3 PHOTOMETER—Provides rapid and precise method of studying spectrographic plates, according to inventor. Instrument enlarges spectral lines about 20 times and provides means of determining their intensities by measuring light passing through them to photoelectric cell. Plate is mounted horizontally and all light-control devices and scales immediately in front of operator. *General Electric Co, Schenectady, N. Y.*

4 MICRO-ACTION VALVE—"Micro-bean" is for dampening pulsation of boiler-plant pump governors, and for eliminating "jitters" of gage hand. Consists of solid brass body in which filter is inserted for protection from foreign matter. Micro-metric control of opening said to enable operator to obtain closest approach to full shut-off, down to last .0003 of an inch, regardless of line load. *J A Campbell Co, 645 E Wardlow Rd, Long Beach, Calif.*

5 TEAR-OFF DEVICE—Tear-off feature can be supplied for Celectray recorders and recorder-controllers made by company. Consists of tear-off bar and re-roll with clip and tape. *C J Tagliabue Mfg Co, Park & Nostrand Ave, Brooklyn, N. Y.*

6 CONTROL THERMOMETER — Wheelco Therm-otrols employ famous "Radio Principle" control. Frequency of oscillating current flowing between pickup coils, which are mounted on temperature-control setting index, is changed when control flag, mounted on pen arm, is moved between coils on temperature arm. This frequency-change in control circuit operates to de-energize a solenoid coil and open relay contacts. *Wheelco Instrument Co, 1929 S Halstead St, Chicago, Ill.*

7 WATER-LEVEL GAGE — Pressure-sealed flat-glass insert for water-level gages built for pressures up to 1500 lb. Features of improved design are pressure-sealed gaskets on inside faces of glasses and spring-load cap screws holding down front and back cover plates. Referring to illustration, cushion gaskets *A* are used on outer faces of glasses *B*. Thin sheets of india ruby mica *C* protect inner surfaces of flat glasses from etching action of steam and water. Special molded Vulcabeston gaskets *D* fit into body recesses on pressure side of glasses and provide tight joints between body and glasses without excessive tightening of covers. Spring cones *F* attached to each cap screw limit the amount of pressure on glasses and gaskets, preventing harmful compression on glasses when covers are tightened down. *Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.*

8 RECYCLING CONTROL — Permutit recycling control is for attachment on meters used for initiation of automatic processes. Control is so constructed that when predetermined amount of water has passed through meter, contact will be made which will start automatic cycle, after which meter control resets itself and is ready to measure predetermined quantity of water before next automatic cycle is started. *Permutit Co, 330 W 42nd St, New York, N. Y.*

INSTRUMENT CHARTS—"Permochart" plastic recording-instrument chart is made of non-flammable oil-, gasoline- and grease-resistant plastic, which will not split or curl. Available in three colors to reduce glare and eyestrain. Charts guaranteed for two years under normal operating conditions. *Permochart Co, Chestnut St, Sewickley, Pa.*

STEP-VOLTAGE REGULATORS — Air-insulated units supplement recent improvements in air-insulated electrical equipment for utilities. In order to reduce costs and space requirements, special transfer and selector switches were designed whereby six transfer switches and a selector switch could replace 18 transfer switches, normally used on 2-phase, oil-insulated, 32-step regulator. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

TEMPERATURE RELAY—Type CFT temperature relay protects machines and transformers against overloading. CFT embodies induction-cylinder design, and supersedes Type ICT induction-disk relay. *General Electric Co, Schenectady, N. Y.*

1 PRESSURE GAGE—Bourdon-tube pressure gage has patented "recalibrator" which provides method of easily and accurately setting pen on zero. Gage construction consists of a one-piece casting supporting bourdon tube, gear and pinion, and pen-arm shaft, making it possible to mount entire assembly in case as one completely calibrated unit. *Brown Instrument Co, Philadelphia, Pa.*

2 FLUORESCENT TESTER—Mitchell tester enables user to test fixtures, bulbs, starters and ballast to determine cause of failure in fluorescent units. Tester tells immediately which of several component parts need replacement. Has two starter adapters that enable testing of lamps from 50 to 100 watts, as well as starters and ballasts for different wattage lamp. *Mitchell Mfg Co, 2525 Clybourn Ave, Chicago, Ill.*

3 HAND TACHOMETER—Centrifugal hand unit should not be confused with type shown originally on page 108, June, 1938 POWER. Former type made almost two full revolutions of dial in each speed range. New instrument has cross pendulum and five speeds. While in old instrument speed ratio was 1 to 12 in each range, new one keeps ratio down to 1 to 4 in each measuring range. *Coats Machine Tool Co, 75 West St, New York, N. Y.*

4 PROPORTIONAL CONTROLLER—Celectray controller fits applications in which throttling control with or without automatic reset is required. Throttling control is accomplished through a simple method. When temperature is far below control point as in starting up, valve will be wide open; as temperature rises and enters throttling zone the valve will close a relay. *C J Tagliabue Mfg Co, Park & Nostrand Ave, Brooklyn, N. Y.*

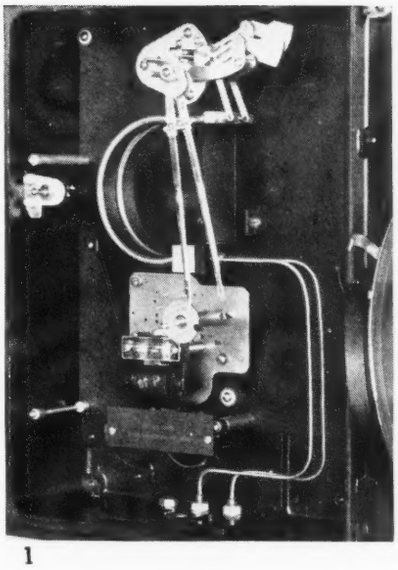
TEMPERATURE INDICATOR—Portable instrument for thermocouple temperature measurements is also used for checking thermocouples and small emf's. Increased accuracy has been provided by calibrating only a small portion of the range on a continuously-adjustable slidewire. No additional accessories required except thermocouple and ice bath for reference-junction. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

GAGE TESTER — MSA velocity power gage tester is device for safety-testing gages used in conjunction with compressed-air storage cylinders, to determine their ability to withstand sudden application of surge pressures encountered under service conditions. *Mine Safety Appliance Co, Pittsburgh, Pa.*

LIQUID-LEVEL CONTROLS—Two additions to "Magnetrol" controllers announced. Models TF-5 and TF-6, for flange and screwed-in mounting respectively, are for tank applications where it is necessary to maintain liquid level between a certain differential. Switches employ no stuffing boxes, bellows, rotary shafts, or packing as media through which movement is transmitted from float to switch element. *Fred H Schaub Engineering Co, 325 W Huron St, Chicago, Ill.*

RECORDER—Low-chart-speed recorders telescope 30-day load and voltage surveys, formerly requiring 60-ft strip chart, into chart 30 in. long. Instrument is addition to GE's line of CF inkless recorders and has chart speed of only 1 in. per day. Recorder is available as ammeter or voltmeter. *General Electric Co, Schenectady, N. Y.*

THICKNESS GAGE—Magnetic gage measures for first time thickness of sheet steel when only one side is accessible. Consists of a 7-lb portable indicating unit and a small cylindrical head containing an alnico magnet. Thickness



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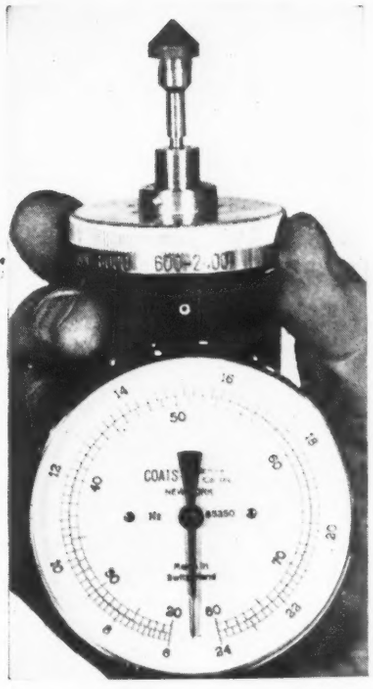

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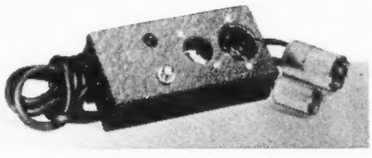

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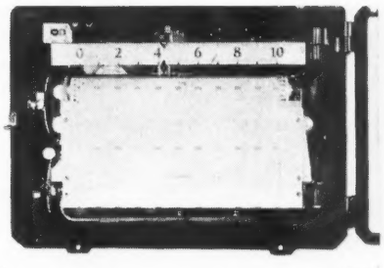


is indicated by instrument reading which is a measure of increased reluctance of magnetic circuit. Thickness of any metal can be found, providing it is not backed by any other magnetic material. *General Electric Co, Schenectady, N. Y.*

MISCELLANEOUS

FIRE-EXTINGUISHER SEALS—"Gardeseals" are bright red trademarked visual signals or handle seals that are destroyed immediately when extinguisher is removed from hook. Tells at a glance whether or not unit has been inspected or used recently. *Pyrene Mfg Co, 560 Belmont Ave, Newark, N. J.*

SENSITIZED METAL—Photographic sensitized metal can be used to make contact prints, etc, from ordinary drawings, regular prints, or negative, by regular photographic printing process. Formerly made on aluminum base, sensitized material now made available for wood and other metals. *Republic Engrg Products, Inc, 480 Lexington Ave, New York, N. Y.*

TAPE—Two-in-one tape is combination of splicing compound and friction tape, and is made with rubber insulation on both sides of strong cotton tape. *B F Goodrich Co, Akron, Ohio.*

FIRE EXTINGUISHER—Extinguishing agent puts out magnesium fires and fires resulting from incendiary bombs, maker says. Product is dry inert compound that stops combustion of magnesium as well as other metals such as sodium, potassium, aluminum and zinc. *Pyrene Mfg Co, 560 S Belmont Ave, Newark, N. J.*

OIL TANK CLEANER—Siloo solvent is positive-acting treatment for cleaning fuel-oil tanks and heating equipment. One quart of solvent is used to each 150 to 275 gals of fuel oil. *Petroleum Solvents Corp, 331 Madison Ave, New York, N. Y.*

DRAFTING MACHINE — True-line drafting machine embodies following instruments: protractor, vernier, T-square, scales and triangles. Protractor may be used at any angle in complete circle, so that total board-area is made accessible. *Frederick Post Co, Hamlin & Avondale Ave's, Chicago, Ill.*

FLUORESCENT LAMP — Hygrade 100-watt fluorescent lamp is 60 in. long, 2⅛ in. in diameter. Produces an average of 880 lumens, and has rated life of 2000 hours. *Hygrade Sylvania Corp, Salem, Mass.*

CONDUCTIVE RUBBER — Compounding of rubber and synthetic rubber produces substance that, according to maker, "has an electric resistivity possibly as low as one-millionth that of ordinary rubber". Designed for use in applications where static electricity exists and where there is danger if sparks fly. *B F Goodrich Co, Akron, Ohio.*

1 STORAGE CABINETS—Steelart cabinets feature streamlined, round-corner construction. Maker says there are no sharp corners and no exposed bolt heads on front or sides. Top and bottom channels inside cabinet act as door stops without projecting into storage area. *Lyon Metal Products, Inc, Aurora, Ill.*

2 WHITEPRINT MACHINE — Model C machine accommodates materials up to 42 in. wide. Blower removes hot air from printing cylinder, cools burner and creates vacuum necessary for automatic separating device. *Ozalid Products Div, General Aniline & Film Corp, Johnson City, N. Y.*

3 BLUEPRINT MACHINE—Model 22-16 is combination of Model 22 printer and Model 16 washing and drying machine. Features include sliding contact, which smoothes out inequalities present in tracing, and 23¾-in. of uninterrupted exposure area; 3-speed lamp control; and actinic arc lamps. *C F Pease Co, 2601 W Irving Park Rd, Chicago, Ill.*

4 DEVELOPING MACHINE—Bruning No. 159 volumatic developer is for use in conjunction with Bruning printer. Developing section is driven by printer and is synchronized to operate at same printing speeds. *Chas Bruning Co, 100 Reade St, New York, N. Y.*

5 GENERATOR FIRE PROTECTION — consists of specially shielded nozzles for discharge of carbon dioxide into ventilating ducts of generators in the event of fire. As shown, nozzles are affixed to both initial and delayed-discharge pipes which carry carbon dioxide from storage cylinders to ducts. *Walter Kidde & Co, 140 Cedar St, New York, N. Y.*

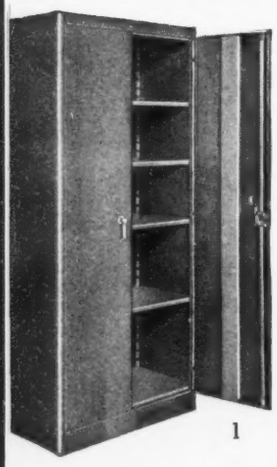
6 METALLIZING GUN—Type 2E gun has two features: "controlled power unit", which gives uniform and steady wire feed for production service and eliminates need for gear changes; and "Universal Gas Head", which allows use of acetylene, propane, hydrogen, natural or manufactured gas with balanced pressures and without changing heads. *Metallizing Engrg Co, Long Island City, N. Y.*

7 POWER FLOAT AND TAMP — Units used in conjunction with Flexrock mastic floors. With power float, drier mixes can be used, preventing segregation and assuring equal distribution of aggregate. Grid tamp is improvement over old methods of floor tamping. *Flexrock Co, 23rd & Manning, Philadelphia, Pa.*

8 WATER FILTER—Radial-fin construction of air filters has been adapted for water filtration. Has no moving parts and large filtering area permits long operating periods without attention. Units can be arranged so that cleaning is effected by backwashing with clean water. *Staynew Filter Corp, Rochester, N. Y.*

9 PRINTING MACHINE—Model 55, 42-in. printer, operates with either cut sheets or roll stock. Entire top of machine serves as print-return tray, and return is so designed that tracing enters tray on top of print. *Chas Bruning Co, 100 Reade St, New York, N. Y.*

10 VACUUM CLEANER—Tornado noiseless cleaner features quietness, power and ease of operation. Attachments and clean-



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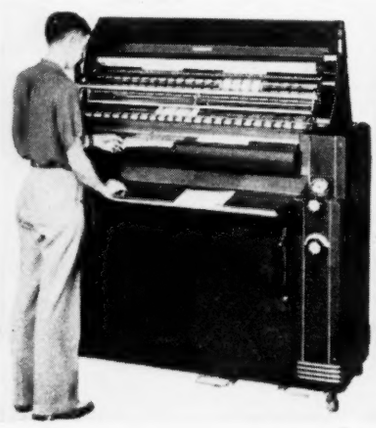

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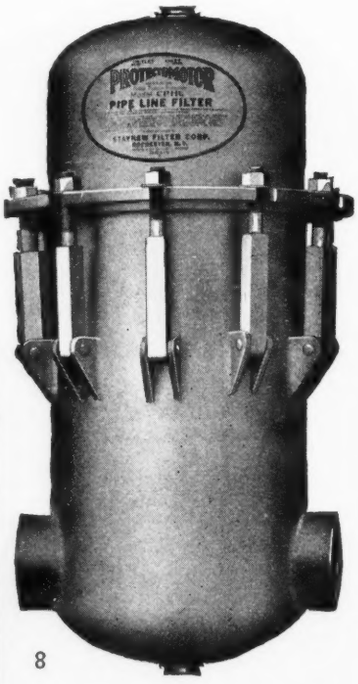

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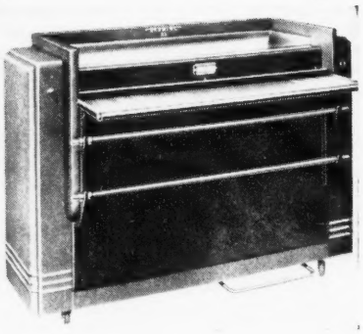

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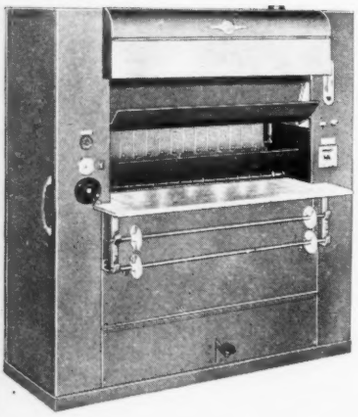

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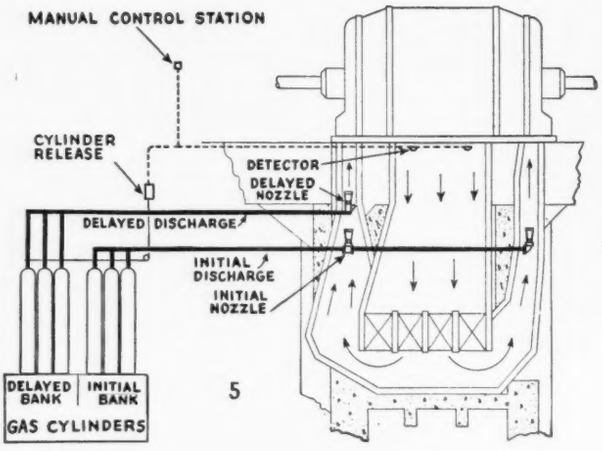

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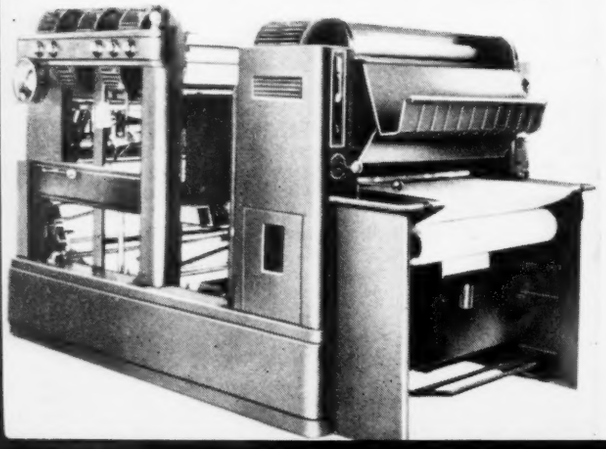

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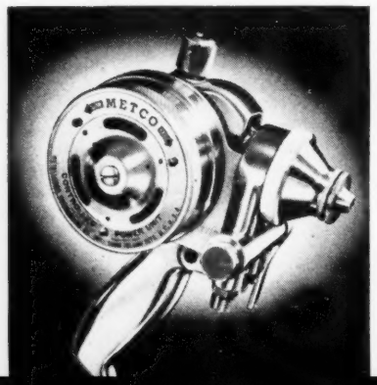


ing tools available for removing dust, litter, chips, etc, from unit in course of assembly. *Breuer Electric Mfg Co, 5100 N Ravenswood Ave, Chicago, Ill.*

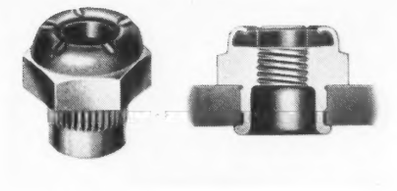
FLOOR GRATING—Klemp welded-steel grating made of hot-rolled hexagonal steel bars placed at right angles on top of flat bearing bars set on edge, electro-welded under pressure. *Wm F Klemp Co, 6611 S Melvina Ave, Chicago, Ill.*

STOP NUT—Thin-hex stop nut is for use on shear bolts where high degree of stress is lateral, and for general applications to light and medium-stress fastenings. *Elastic Stop Nut Corp, 2332 Vauxhall Rd, Union, N. J.*

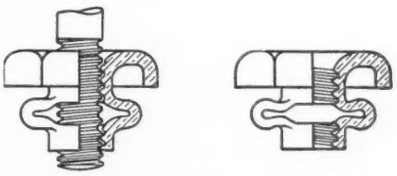
RUST PREVENTIVES—Basic material provides homogeneous non-crystalline film, with high degree of cohesion as well as adhesion to metals. It wets out surface rapidly, making a non-tacky unbroken film impervious to atmospheric conditions. *E F Houghton & Co, Third & Somerset St, Philadelphia, Pa.*

COPPER—Rocan copper available in standard stock sizes in sheets, rolls and strips, which are applied in same manner as commercial sheet copper. Tensile strength of new material, as well as its endurance limit in corrosion fatigue, is said to be substantially higher than that of electrolytic copper. *Revere Copper & Brass, Inc, 230 Park Ave, New York, N. Y.*

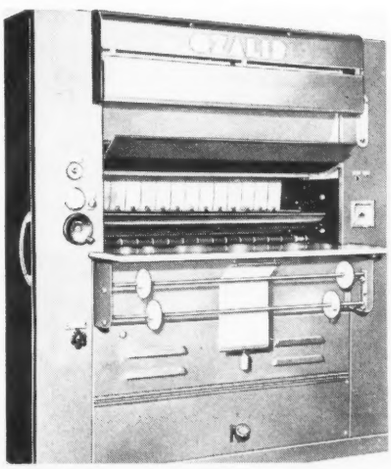
REGALVANIZING PROCESS—Permits welding or galvanized or other sheets and structural parts, so that joints are left in rust proof condition. Consists of rubbing bare spots, which have been heated by welding, with a stick of low-melting galvanizing material to form a smooth coating of metal that will have all the corrosion-resisting properties, as well as wearing qualities of original galvanized coating. *Galv-Weld, Inc, Mutual Home Bldg, Dayton, Ohio.*



LOCK NUT—(Top photo)—Unit is used for fastening sheet metal assemblies in which parts must be readily removed. Consists of clinch-type lock nut with knurled shank. Nut head is fitted with vulcanized fibre collar characteristic of company nuts. *Elastic Stop Nut Corp, 2332 Vauxhall Rd, Union, N. J.*



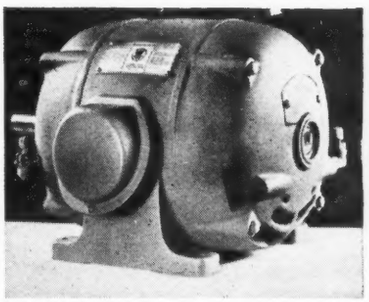
LOCK NUT—(Center photo)—Boots self-locking wing-style nut is said to present all advantages of solid-type nut, but weighs less and costs less. Drawing at right shows hexigon nut when not in use. At left, nut is in use in screw or bolt and spring member is expanded to its locking position. *Scovill Mfg Co, 99 Mill St, Waterbury, Conn.*



WHITEPRINT MACHINE—(Bottom cut)—Ozalid model B machine capable of producing finished whiteprints at speeds up to 20 ft per min. Machine features synchronizing printing and developing, temperature control for printing cylinder, and special light above print receiving tray enabling operator to check prints for correct printing and developing speeds when prints are delivered at the rear of the machine. Other features include front or rear print delivery, adjustable burner shade to permit running prints of varying opacity without changing printing speeds, automatic air pickoff, and effective blower hookup. *Ozalid Products Div, General Aniline and Film Corp, Johnson City, N. Y.*

MOTORS, SWITCHES AND OTHER ELECTRICAL EQUIPMENT

1 INDUCTION MOTORS—Open-type squirrel-cage motors designed for general-purpose drive applications such as pumps, etc. Available in ratings from ½ to 5 hp, at speeds from 875 to 3600 rpm. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*



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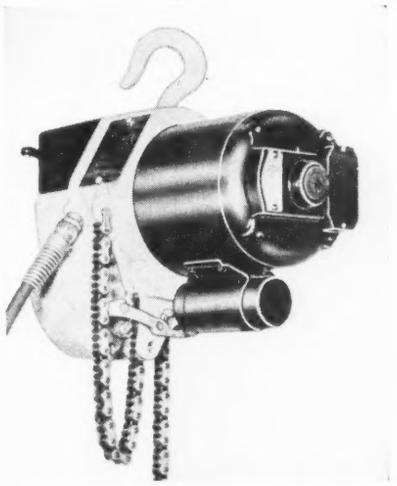
2 REVERSING MOTOR—Capacitor-start reversing motor for cranes, hoists, and other uses where instantaneous reversing is necessary. In operation, drum switch is closed, setting up power circuit through solenoid relay and motor windings. Relay transfers circuit from lower to upper contact, and locks relay across the line. Line voltage across main and starting windings starts the motor. To reverse simply throw switch to other side. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

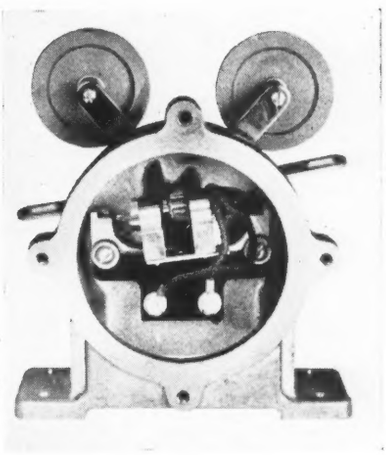
2

3 FLOAT SWITCH—Uses snap-action mercury contactor and is built entirely of non-corrosive materials. Designed and packaged for field man, unit comes complete with bracket for wall mounting. *Automatic Control Co, 1005 University Ave, St. Paul, Minn.*



4 INDUSTRIAL LAMPS—High wattage industrial lamps have been reduced in size and made with weatherproof glass to withstand thermal shocks. Photo shows both lamps, newer one at left, showing sizes. *Radiant Lamp Corp, 333 Sherman Ave, Newark, N. J.*

INFRA-RED LAMPS—Nalco inside silvered lamps with carbon filaments developed for infra-red ray processes in drying, baking, heating and dehydrating. Silver in base end acts as reflector. *North American Electric Lamp Co, 1097 Tyler St, St Louis, Mo.*



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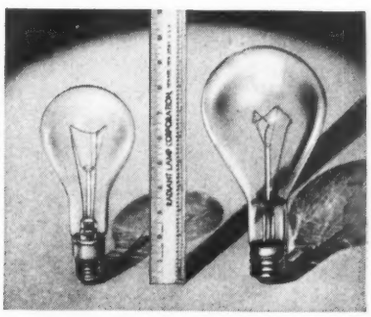

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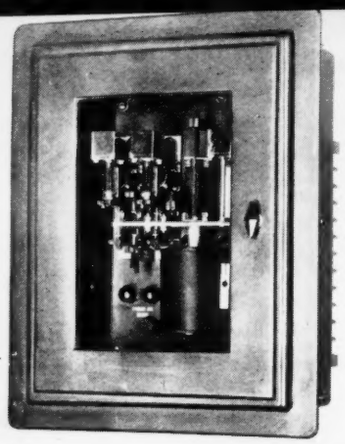

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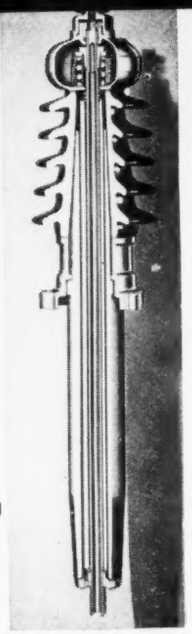

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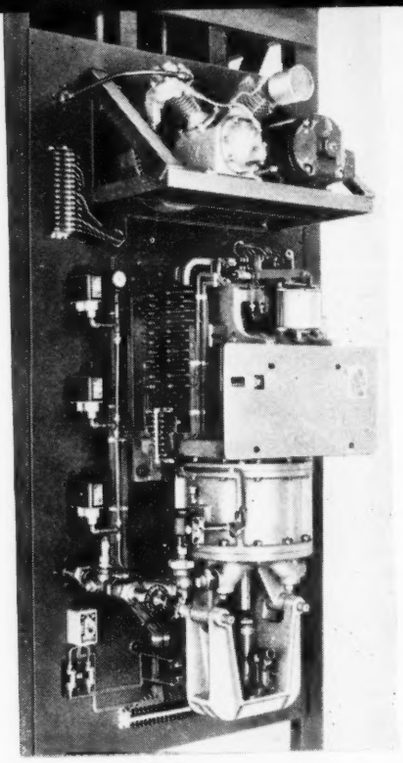

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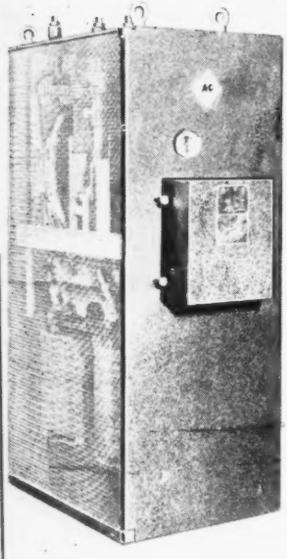

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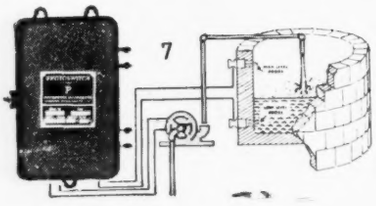

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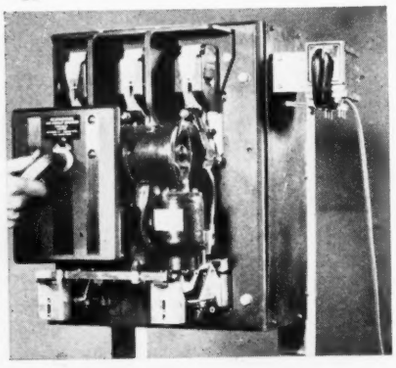

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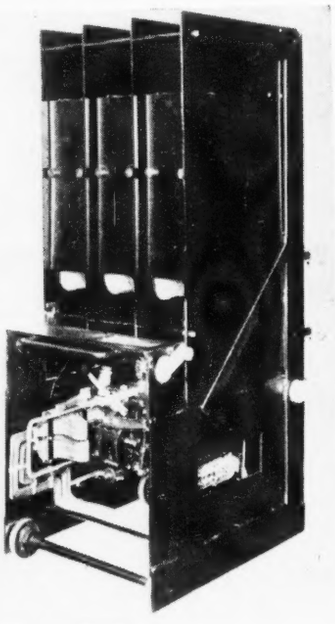

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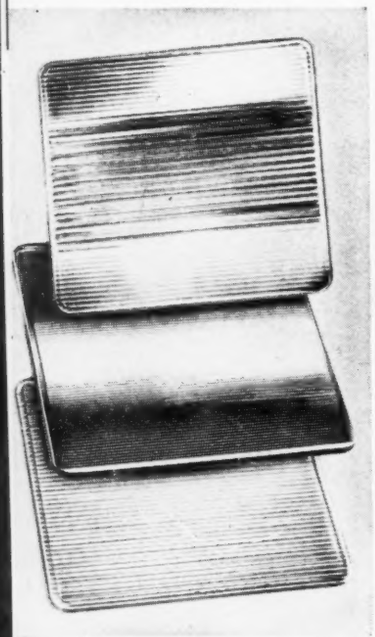

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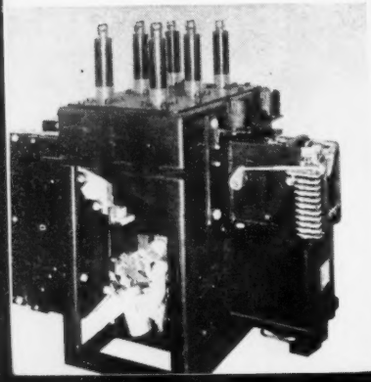
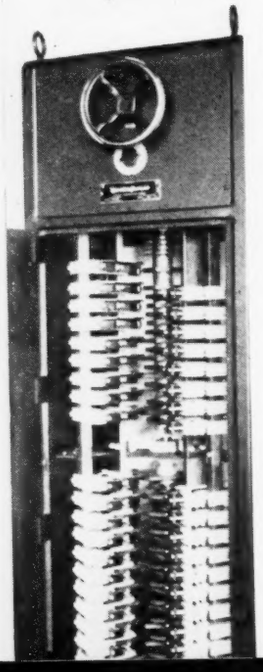
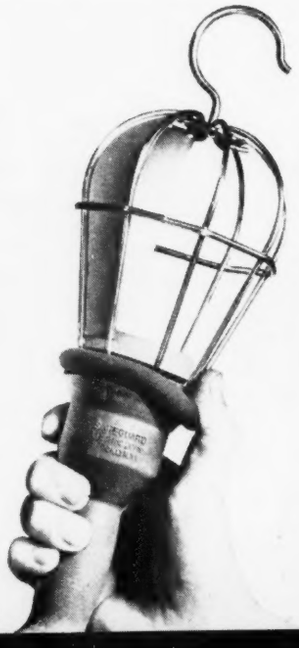
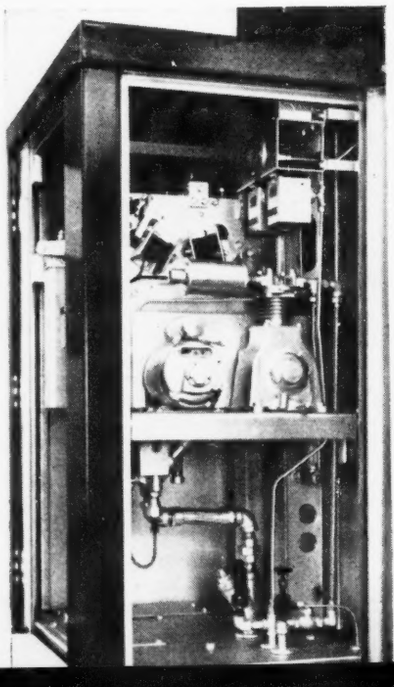








1 SPLASHPROOF MOTOR—Tri-clad motor now announced in sizes from 1 to 15 hp supplementing Tri-clad line. Ventilated openings block entrance of splashing liquids. *General Electric Co, Schenectady, N. Y.*

2 AIR-COOLED REGULATOR—Dry-type air-cooled regulator is step-type unit, having 32⅝% steps, to provide ∓10% regulation. Dry operation permits easy inspection, as single door makes all working parts accessible. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

3 CONTROL LENSES—Fluorescent Control-lenses are prismatic lenses, which, when used with fluorescent fixtures, will produce three basic distribution lighting patterns, intensive, concentrating, and extensive. *Holophane Co, 342 Madison Ave, New York, N. Y.*

4 CIRCUIT BREAKER—Magne-blast circuit breaker announced in higher ratings to meet demand for breaker for severe industrial service. Maker says higher insulation and service-voltage ratings have been obtained by careful coordination of insulation in arc chute, increased phase spacing and a separate box-carrier for each phase. *General Electric Co, Schenectady, N. Y.*

5 VOLTAGE REGULATOR—Indirect-acting rheostatic generator voltage regulator is for automatic control of medium and large generators in central stations or large municipal and industrial plants. Operational feature is its high-speed action time of 3 cycles after a voltage change. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

6 HAND TACHOMETER—Ac tachometer developed to eliminate undesirable features of dc unit. Ac voltage generated is rectified and indicated in terms of rotational or linear speeds. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

7 LEVEL CONTROL—Photoswitch level control provides on-and-off valve control of any liquid. Complete equipment available for single-level indication and control, on-and-off pump-up and pump-down control and low-level safeguards. *Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.*

8 THERMOCOUPLE FURNACE—Checking furnace for thermocouples consists of small electric furnace which provides zone of practically uniform temperature for the intercomparison of laboratory and plant standard couples. New accessory that increases checking accuracy is cylindrical copper equalizing block that fits inside furnace. *Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa.*

9 SECONDARY CONTROLLERS — Secondary control is for use with polyphase wound-rotor motors on fan, pump and similar drives. Provides either 13 or 20 balanced points of control by varying external resistance in motor secondary winding. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

10 BUSHINGS—Oil-filled apparatus bushings have been improved. Illustration shows O-B Class L bushing with quarter-section removed, with new type oil-expansion chamber, one type of draw-lead terminal and large amount of internal porcelain. *Ohio Brass Mfg Co, Mansfield, Ohio.*

11 GROUND CONNECTOR — Illustration shows non-corrosive ground clamp for driven rod or pipe. Can be slipped over rod top as one-piece assembly. *Burndy Engrg Co, Inc, 459 E 133rd St, New York, N. Y.*

12 CIRCUIT BREAKER—New breakers are equipped with rotary, removable operating handle for controlling breakers manually. In addition, electric operation can be provided by motor mechanism and shunt trip. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

13 EXTENSION LIGHT—Safeguard portable lamp guard has rubber handle, to which is attached a metal cage by means of rubber locking ring. When it becomes necessary to replace lamp, merely snap back rubber ring, insert new bulb, and re-snap ring in place. *Safeguard Electric Co, 1 De Kalb Ave, Brooklyn, N. Y.*

14 BREAKER OPERATOR—For high-speed operation of large outdoor oil circuit breakers uses normal operating pressure-range from 80 to 125 lb per sq in. Storage tank accumulates enough air for three closing operations before recharging is necessary. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

15 CIRCUIT BREAKER—De-ion unit employs special magnet coil to draw out arc quicker to be quenched. Closing operation is of solenoid type, with mechanism mechanically and electrically trip free. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

16 OPERATING MECHANISMS—Pneumatic operators for GE outdoor oil-blast breakers require low operating current, and design provides fast operation without abnormal stresses on breaker. *General Electric Co, Schenectady, N. Y.*

17 BUS SUPPORT CLAMP—Device may be used alternately as slide-fit or rigid support by simply clamping caps in desired position. Circled inset shows position of clamp when slide fit on conductor is desired. *Burndy Engrg Co, 459 E 133 St, New York.*

18 BALANCING MACHINE—Portable dynamic balancing machine consists of three principle parts: sine-wave alternator, vibration-velocity unit, and indicating unit with its associated circuits, all in carrying case. Rotors may be checked while running in their own or substitute test bearings. *General Electric Co, Schenectady, N. Y.*

19 DISTRIBUTION TRANSFORMERS — Transformers announced in accordance with first report of EEI-NEMA committee on standardization. Designed for direct-pole mounting. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

ADJUSTABLE LAMP SOCKET—"Swivilier" socket adjustable to full 90 deg, and can be rotated to describe complete circle when adjusted at any angle. *Reliance Devices Co, 140 Liberty St, New York, N. Y.*

THERMOSTAT — Heavy-duty unit comprises thermostatic element suitable for electric-heater loads of 1500 watts at 115-230 volts ac. *George Ulanet Co, Newark, N. J.*

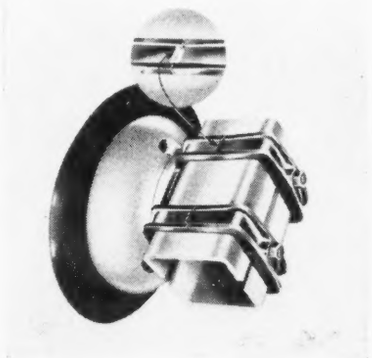
GLASS INSULATION — Irvington varnished Fiberglas is glass cloth base (Owens-Corning Fiberglas) impregnated and coated with heat-resisting varnishes developed especially for insulating purposes. *Irvington Varnish and Insulator Co, 24 Argyle Terrace, Irvington, N. J.*

RESISTORS — Ohmite wire-wound vitreous-enameled resistors available in "live" and "dead" bracket types for special applications. Both types used for signal circuits, etc. *Ohmite Mfg Co, 4835 Flournoy St, Chicago, Ill.*

PUSHBUTTON STATION—No. 202 Colt is styled for use with streamlined machines, designed for surface mounting. Internal mechanism is self-contained on rugged molded block, mounted directly on metal base. *Electrical Div, Colt's Patent Fire Arms Mfg Co, Hartford, Conn.*

TRANSFORMER—"Noflamol" non-inflammable transformer is filled with non-inflammable synthetic liquid developed recently. *Wagner Electric Corp, 6400 Plymouth Ave, St Louis, Mo.*

SERVICE LAMP—Vibration-service lamp has construction which protects filament from vibration and is designed for industrial and commercial use where high-frequency vibration set up by motors and machinery in constant use tends to weaken average bulb's filament and shorten its life. *Wabash Appliance Corp, 335 Carroll St, Brooklyn, N. Y.*



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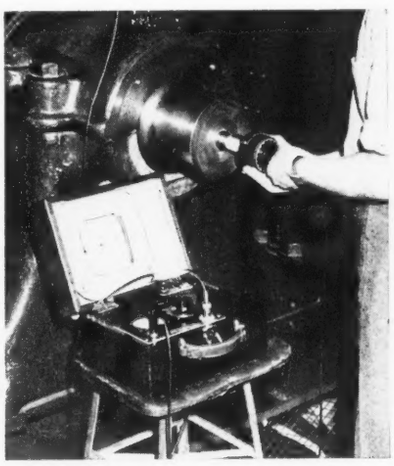

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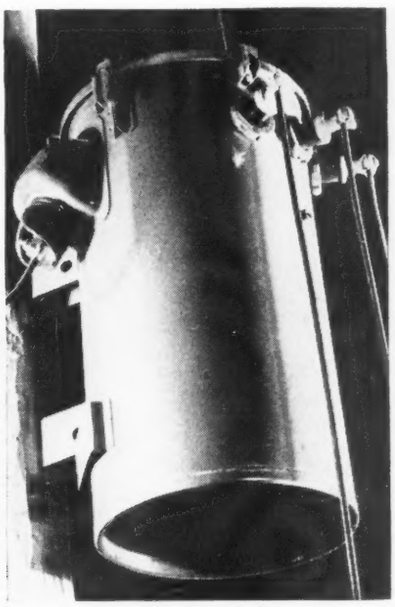

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1 CONNECTOR—Type ER connector illustrated is used to join copper-cable conductors on end, parallel to each other, or at an angle. Can also be used as coupler or reducer. *Burndy Engrg Co, 459 East 133rd St, New York, N. Y.*

2 JUMPER STICK—Permits replacement of first fuse link in GE reclosing cutout without service interruption. Replaces cable jumper formerly used, which required connections with screw clamps ot cutout leads. Unit is Herkolite tube, housing two cast-bronze nickel-plated contacts separated by stainless-steel compression ring. *General Electric Co, Schenectady, N. Y.*

3 CIRCUIT BREAKER—Flex-a-plug consists of heavy-duty switch or Type AT circuit breaker in combination with pyranol-filled capacitor. Plug can oe used to improve system power factor. *Trumbull Electric Co, Plainville, Conn.*

4 INDICATING LAMPS—Lamps for visual or pilot-light indication on switchboards, switchgear, etc. Feature is special material in color cap which allows less lamp voltage with equal brilliance and corresponding longer lamp life. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

5 ENGINEER'S LIGHT—Fluorescent lamp has special pigment-treated reflector which balances blue light common in lamp and produces neutral colorless light. Illustration shows model 2224A, fastened to drawing surface by clamp. *Frederick Post Co, P O Box 403, Chicago, Ill.*

6 CAM LIMIT SWITCH—Cam-operated limit switch is made with contacts arranged to swing open for inspection and maintenance, and is designed specifically for control circuits of hoists, industrial trucks, etc. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

7 TRANSFORMER — Indoor current transformers have practically flat ratio and phase-angle curves from 15 to 200% current, resulting in high metering accuracy over wide load. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

8 CAPACITOR MOTOR—Capacitors on recently announced Tri-clad motors are mounted inside end shield on normal-torque units, illustrated, while on high-starting-torque motors 1½ hp and larger, they are mounted in compact case on top of motor frame. *General Electric Co, Schenectady, N. Y.*

9 AC GENERATOR—Addition of new 110/220-volt, 10-kva single-phase ac generator to line announced. Illustration shows unit with end shield cover removed. *Kato Engrg Co, Mankato, Minn.*

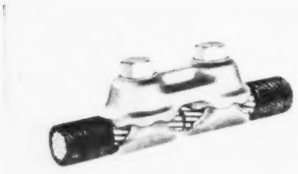
10 TACHOMETER — Measures revolutions per minute, feet per hour, gallons per minute. Consists of alternating-current generator and voltmeter of rectifier type. Rotating element consists of laminated iron keyed to rust-resisting steel shaft. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

11 RELAY—Improved ac tripping form of IAC relay rated to interrupt 100 amp around a trip coil. New design employs thicker contact brush and more massive contacts. *General Electric Co, Schenectady, N. Y.*

12 MOTOR STARTERS — Magnetic motor starters constructed for across-the-line starting of single and polyphase squirrel-cage induction motors, and as primary control for wound-rotor induction motors. *Electrical Div, Colt's Patent Fire Arms Mfg Co, Hartford, Conn.*

13 ELECTRIC MOTORS—New Century motors provide necessary protection where air is foggy with metal-cutting solutions, or where there are abnormal quantities of metallic abrasive or other dusts in the atmosphere that would ordinarily injure or clog windings of general-purpose open motor. *Century Electric Co, 1806 Pine St, St Louis, Mo.*

14 FREQUENCY CONVERTER—This unit provides 30-cycle half-wave supply, with its 1800 vibrations per minute, for vibrating screens, conveyors, and others, from a 60-cycle line, and replaces a 15-cycle motor-generator set. *Clark Labs, Palm Springs, Calif.*



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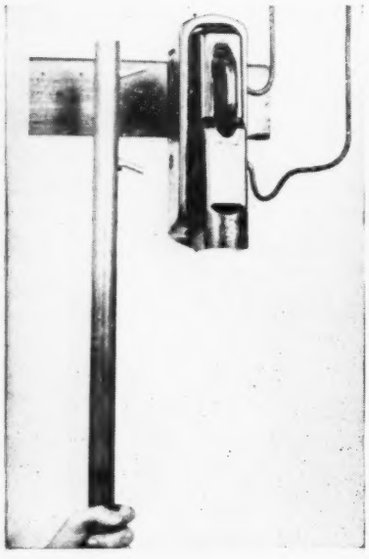

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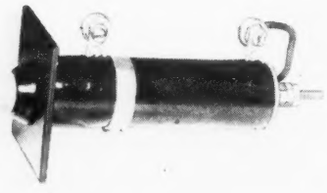

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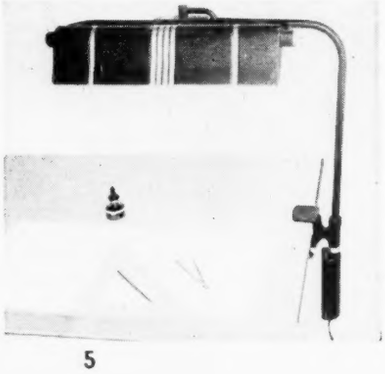

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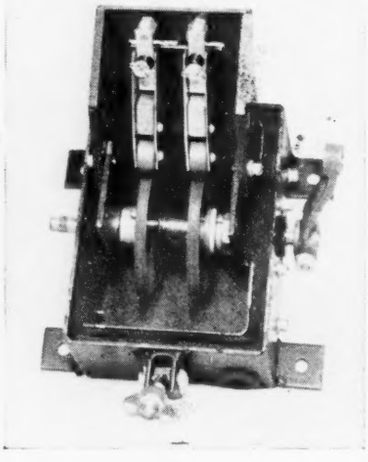

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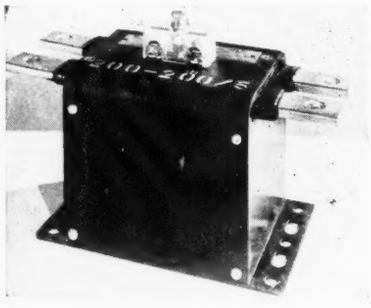

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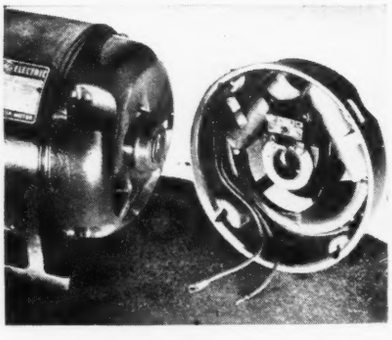

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15 VOLTAGE REGULATOR—Silverstat Jr is for automatic voltage control of small ac and dc generators. Regulator performs continuously, in automatic and much quicker manner, same operation as obtained by hand manipulation of field rheostat of machine under manual control. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

DISTANCE RELAY—Redesigned unit incorporates new features to simplify testing and maintenance. New factors include timing unit with cast-metal base in which mounting bosses and bearing supports are brought together into a single unit. Testing is made easier by having end leads of each current and potential coil brought out separately. *General Electric Co, Schenectady, N. Y.*

LAMP FIXTURES—Open-end twin-lamp luminaire for fluorescent lamps is designed specially for high-level illumination in industrial plants, and utilizes 100-watt 60-in. white or daylight fluorescent lamps. Unit consists of a hood, reflector, lamp holders, starting device and ballast equipment. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

SWITCHGEAR—Designed for oil-refinery service, unit has all features of GE standard metal-clad switchgear in general industrial service, plus number of features to meet special requirements of industry. *General Electric Co, Schenectady, N. Y.*

MULTI-BREAKER—Industrial 230-volt breaker can be applied as motor circuit switch or service disconnect switch. Unit is fuseless, with bi-metallic strip actuation, visual trip indication and trip-free lever. *Cutler-Hammer, Inc, Milwaukee, Wis.*

CIRCUIT INTERRUPTER—Non-automatic enclosed circuit interrupter has high capacity and reduced mounting space. Sheet-steel, dust-resisting unit is designed to replace non-automatic disconnecting devices in industrial plants, substations, etc. Safety features include cover interlock. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

INDUSTRIAL LAMP—High-intensity fluorescent fixtures use two 100-watt lamps and are built of extra-heavy-gage sheet steel. Provided with white vitreous-porcelain-enameled reflector, and has open ends, making it adaptable to strip mounting. Units corrected for power factor. *Mitchell Mfg Co, 2525 Cylbourn Ave, Chicago.*

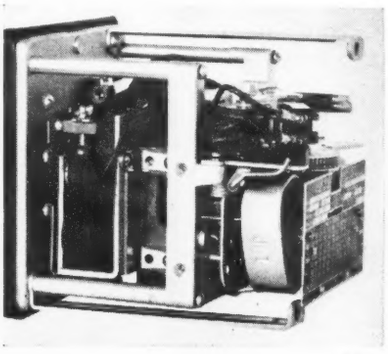
ELECTRICAL PORCELAIN—"Prestite" said to have dielectric strength equal to that of wet-process porcelain, mechanical strength about 10% greater under tension and cantilever loads. For a given dielectric strength a Prestite part can be made about a third the size of equivalent dry-process piece. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

LAMP STARTER — Mirastat fluorescent-lamp starter available for use with lamps from 15 to 100 watts. Improvements claimed for patented starter include elimination of "sputtering," retardment of lamp blackening, longer lamp life, and definite, accurately timed starting and re-starting. Mirastat also interchangeable with glow-relay types of starters using same type socket. *Hygrade Sylvania Corp, Salem, Mass.*

1 WELDING RECTIFIER—Unit consists of control and protective panel, see illustration on following page, power transformer and ignitron tubes, all contained in forced-ventilated, floor-mounted, sheet-metal cabinet, with heavy welded-base frame. Each rectifier will operate two welders if they are sequenced so that only one can be loaded on rectifier at same time. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

2 PHOTOELECTRIC SWITCH—"Sunswitch" is used to control electrical circuits in accordance with rise and fall of natural illumination. User chooses two lighting levels at which he wishes load switched on and off, then adjusts calibrating dials to corresponding footcandle readings (photo next page). *United Cinephone Corp, Torrington, Conn.*

3 CONNECTOR—Burndy "Hottap" suited to taking taps from either cable or flat bar, or for grounding, temporary (see page 82)



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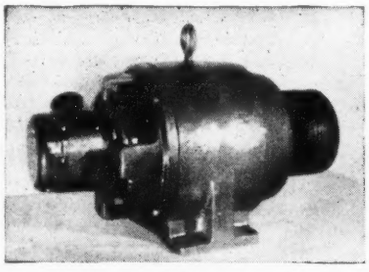

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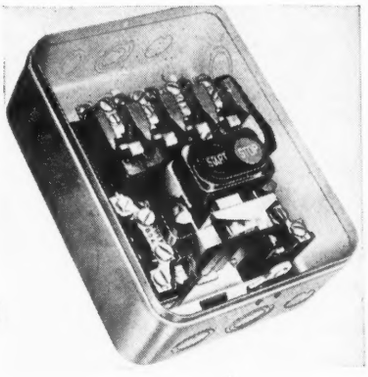

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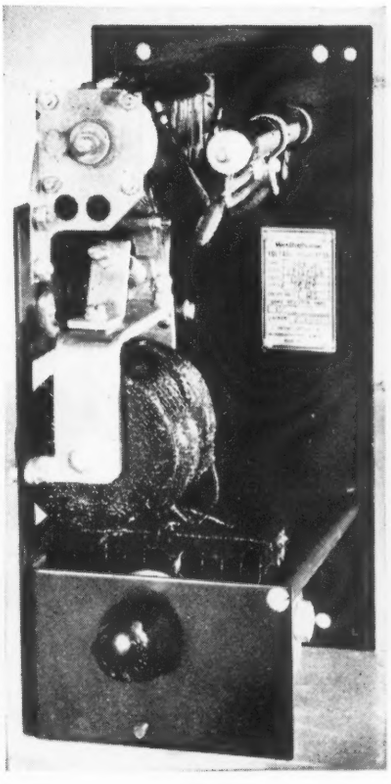

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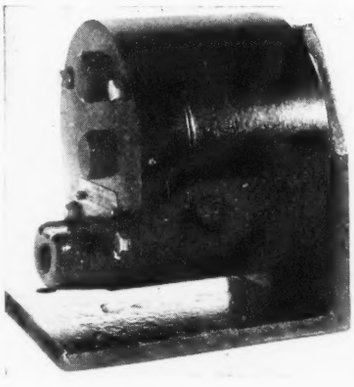

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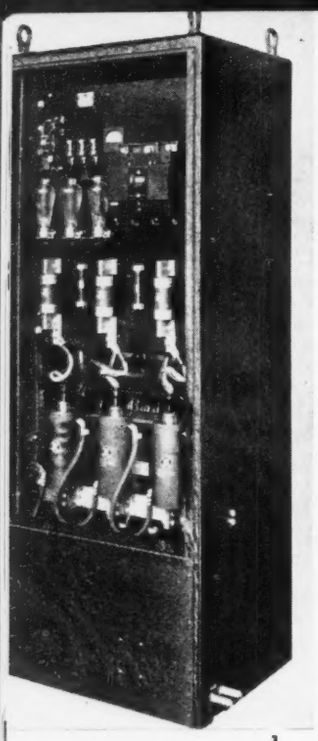

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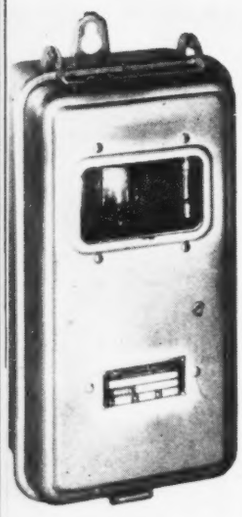

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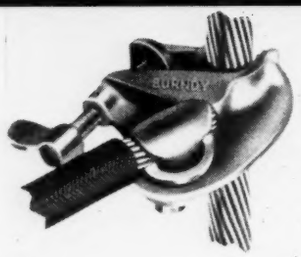

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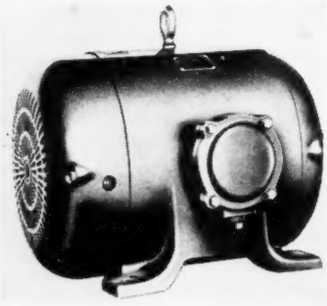

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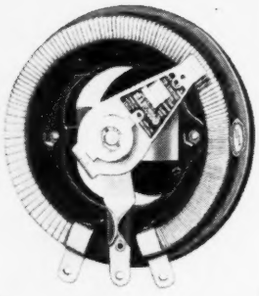

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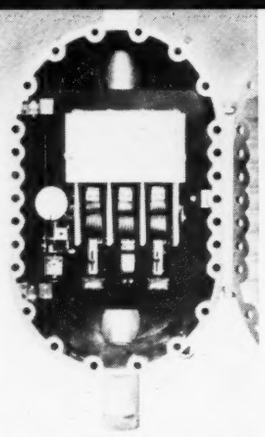

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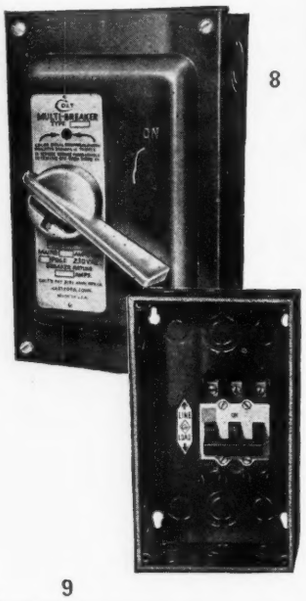

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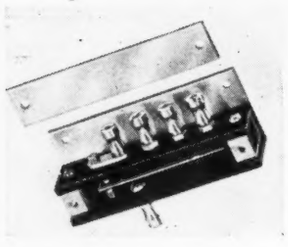

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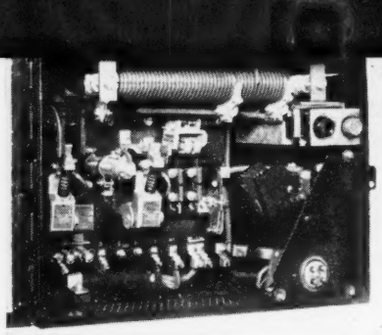

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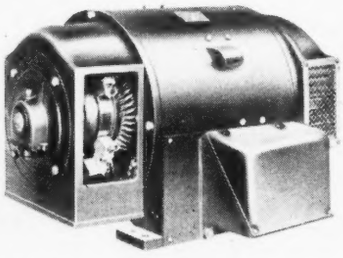

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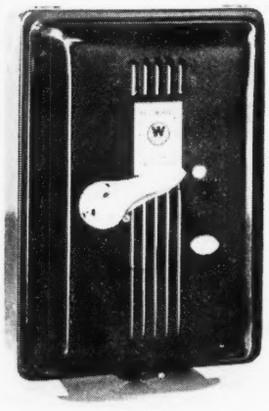

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taps, and jumping equipment being repaired or replaced. Jaws which grip live conductor have grooved contacts designed to clamp cable and serrated contacts which may be used to clamp flat bar securely. *Burndy Engrg Co, 459 E 133rd St, New York, N. Y.*

4 EXPLOSION-PROOF MOTOR — Century motor meets specifications and carries label of Underwriters' Laboratories, Inc, for Class I, Group D installations—where surrounding atmosphere is charged with explosive quantities of acetone, alcohols, gasoline, lacquer, naphtha, natural gas, petroleum or solvent vapor. *Century Electric Co, 1806 Pine St, St Louis, Mo.*

5 GENERATOR RHEOSTAT — Ohmite field rheostats are tapered or uniformly wound, as desired, designed to provide control for separately or self-excited generators. By providing practically continuous variations of resistance in smallest sizes, they effect saving in control-panel space. *Ohmite Mfg Co, 4835 Flournoy St, Chicago, Ill.*

6 TERMINAL STRIPS—Six-barrier strip series used for interconnection of electrical circuits, where maximum metal-to-metal spacing is required. Body is heavy molded Bakelite, with barriers between each set of terminals, following around strip edge of and terminating with base. *H B Jones, 2300 Wabansia Ave, Chicago, Ill.*

7 AIR CIRCUIT BREAKER—GE Type AE-1B air breakers now available in explosion-proof boxes for applications in all groups of Class 1 locations as defined in National Electrical Code. Breaker is rated 25,000 amp interrupting capacity, 600 volts ac, 250 volts dc, for continuous currents up to 600 amp. *General Electric Co, Schenectady, N. Y.*

8 CIRCUIT BREAKERS—Addition of Types M1 and M2 industrial breakers to company line announced. Both furnished with thermal and magnetic trip. Thermal trip gives time delay on small overloads, while magnetic trip assures instant operation on dangerous short circuits or high overloads. *Electrical Div, Colt's Patent Fire Arms Mfg Co, Hartford, Conn.*

9 TIME-DELAY SWITCH — Designed for laboratory and industrial application in conjunction with magnetic relays and generally used where temperature changes are fairly constant and slight variations in timing are not detrimental. Units provided with four terminals, two for heater coil and two for main circuit. *Betts & Betts Corp, 552 West 52 St, New York, N. Y.*

10 COMBINATION STARTER—Remote and automatic control for mining equipment such as conveyors, pumps, fans, etc, provided in dc combination starter. When accurate definite speed is desired, small adjustable-field rheostat may be added. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

11 DC MOTORS—Feature compactness and improved protection. New design of rolled-steel frame and improvements in end-shield and bearing-bracket construction help give protection from external damage. Motors in larger ratings have such features as new ventilation system, and extra protection of all current-carrying and rotating parts. *General Electric Co, Schenectady, N. Y.*

12 CIRCUIT BREAKER — De-ion enclosed circuit breaker is designed for protection of light and power circuits and is made in four frame sizes, including ratings from 15 to 600 amps in steps corresponding to commercial wire sizes. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

13 CABLE DEAD END—Illustration shows Type YE cable dead end. Thick-walled cable socket is indented on cable end by hydraulic press. *Burndy Engrg Co, 459 E 133rd St, New York, N. Y.*

1 CONTACTORS—Colt general-purpose contactors provide safe and convenient method of remotely controlling electric circuits from one or more pushbutton stations or pilot devices. To facilitate wiring, entire unit may be removed by loosening one screw. *Electrical Div, Colt's Patent Firearms Mfg Co, Hartford, Conn.*

2 EMERGENCY LIGHTS—Exide systems, used in connection with either "Chloride" or "Flat Plate" battery, have automatic transfer switch which shifts battery to emergency lighting circuit upon failure of normal ac supply. Battery is kept fully charged at all times. Unit is placed on trickle-charger as soon as emergency period is finished. *Electric Storage Battery Co, Philadelphia, Pa.*

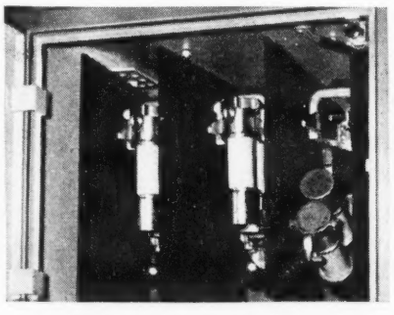
3 MOBILE CAPACITOR—Portable unit will provide on-the-spot correction for reactive current at any point on distributing system; raise power factor at transformer banks, and substations temporarily; and provide actual field checks on calculated capacitor installations at specific system locations. Can be used on 2300-volt, 3-phase, 3-wire, or 4000-volt, 3-phase 4-wire circuits with either manual or automatic control. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

4 EXCITER—Regulator and exciter combined in one unit used for steel mill drives and other applications. Rotating regulator reduces first cost of generator installation, because of 2-in-1 feature. Consists of differential amplifier for controlling excitation on dc motors and generators to give constant voltage, current, speed or tension. *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

5 COMBINATION STARTER—Bulletin 712 starters have unique handle-locking arrangement and compact high-capacity disconnect switch. Disconnect-switch lever is located in front instead of side of box, and cover of box cannot be opened unless disconnect switch lever is "open." *Allen-Bradley Co, 1311 S First St, Milwaukee, Wis.*

STARTER SWITCH — "No-Blink" starter switch is designed specifically for 40-watt Mazda fluorescent lamp, and will eliminate blinking and flickering of burned-out tubes. Unit accomplishes this by ending lamp's life when it has reached the stage where it blinks on and off. Said to lengthen starter life, by eliminating attempts at starting and restarting with faulty bulb. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

STARTERS — (Below) — General-purpose starter designed for protection against short circuits and overloads. Consists of oil-immersed contactor with self-cleaning copper tips, wide metal bearings and copper-braided shunts, with current limiting fuses for short circuit protection. *General Electric Co, Schenectady, N. Y.*



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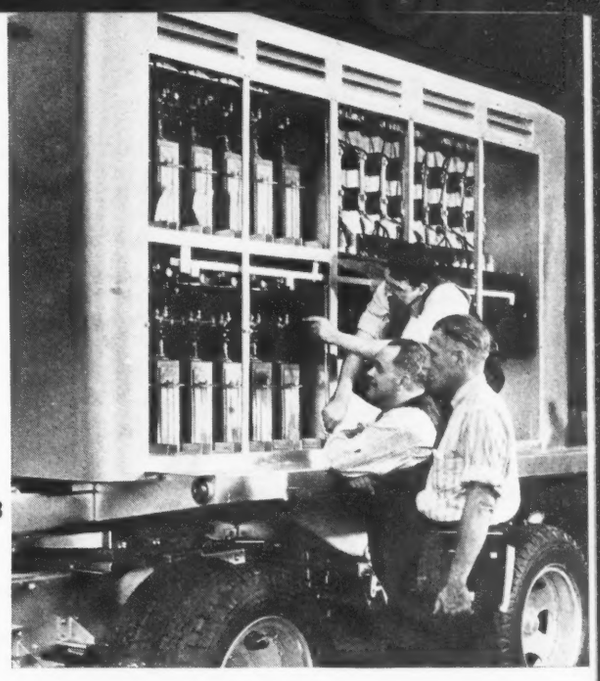

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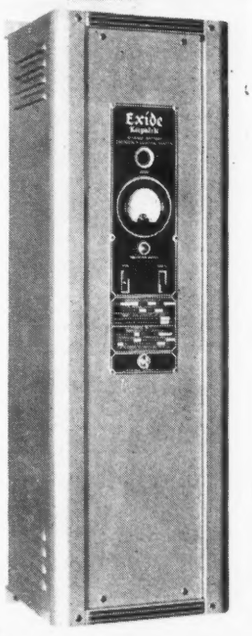

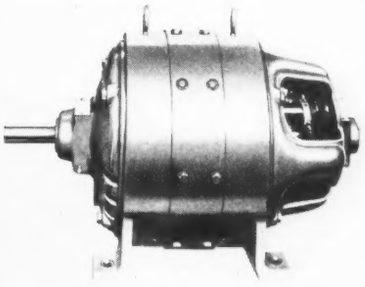

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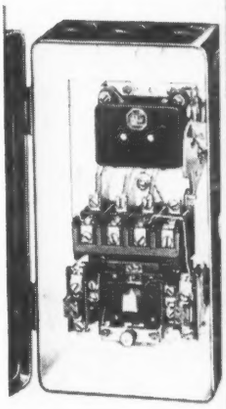

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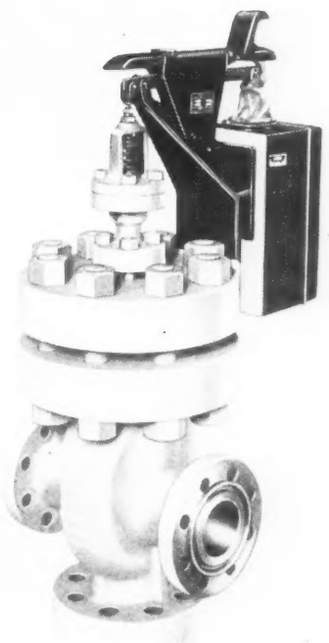
PIPING, FITTINGS AND VALVES

POWER CONTROL VALVE—Ashcroft control valve is automatic relief valve that may be set for a 1% or less difference between opening and closing pressure; said to effect a large saving over 4% required for spring-loaded safety valves. Not intended to replace spring-loaded units. Boiler drum, in operation, or superheater outlet pressure actuates a pressure control set at popping pressure, which operates an electric contact on a difference in pressure of 1% or less. Electric current is transmitted to a solenoid which opens and closes the pilot valve. When this opens it unbalances the pressure over the main valve disk, and it opens and remains open until the pilot valve is closed. Whole cycle of operation is almost instantaneous. Valve opens exactly at popping pressure and closes cleanly with extremely low blow-down. (Photo at right) *Consolidated Safety Valve Div, Manning, Maxwell & Moore, Bridgeport, Conn.*



RELIEF VALVE—Designated as No. 129, snap-action safety relief valve is for hot water heating boilers and has large capacity to take care of boilers with gross Btu output up to 350,000 lb per hr. Has flexible leak-proof bellows, which takes the place of the usual diaphragm, stainless metal-to-metal valve which replaces usual composition disk. *McDonnell & Miller, Room 1305 Wrigley Bldg, Chicago, Ill.*

1 THERMO DRAIN—Improved thermo drain prevents freezing of steam traps when they are outdoors. Any interruption in steam supply will drop temperature and cause thermic element to bend and pull ball-valve away from seat, allowing condensate in line to drain to ground. When steam is again turned on, rising temperature flexes thermic element in opposite direction, closing valve. Thus condensate must pass up through trap in usual manner. *Armstrong Machine Works, Three Rivers, Mich.*

2 MANUAL RESET VALVE—Series NR-1-2 control is operated by external magnetic operator. On current failure, valve closes and cannot be opened until current is available, and then only by manually resetting it. *General Controls, 801 Allen Ave, Glendale, Calif.*

3 PIPE COUPLING — Dillon pipe coupling consists of housing, see illustration, made in two parts, bolted together, and rubber multi-seal ring that fits over pipe ends and is held in place by housing. With multi-seal ring there are three points of contact on each side of pipe joint and because of this construction, says maker, it is impossible for fluid or gas to leak past seals. *Dillon Co, 220-C East Brady St, Tulsa, Okla.*

4 PIPE COUPLING—Couplings for plain-end pipe consists of internal sleeve surrounding two pipe ends, against which suitable gaskets are forced by means of inter-engaging body castings drawn together by bolts. Can also be used as expansion joints. *Regor Products Co, 333 Kearny St, San Francisco, Calif.*

5 PIPE INTERSECTION CUTTER—"Fall-O-Matic" machine will cut any size pipe to fit any pipe of same size, or larger, at any angle or offset. In illustration, a piece of 6-in. pipe has been cut to fit an 8-in. pipe at an angle of 45 deg, with a 1-in. offset. *Spence Engrg Co, Inc, Walden, N. Y.*

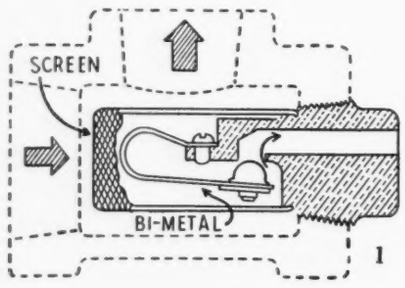
6 VACUUM TRAP—Self-venting vacuum trap has following features: will heat radiator immediately, eliminates and prevents back-pressure in return line, prevents radiator from becoming air-bound, locates defective element, makes radiator and system noiseless, prevents knocking and cuts fuel costs. When defective element is collapsed, steam condenses in air vent, causing hissing sound, and providing warning. *K & M Heating Specialties Co, Empire State Bldg, New York, N. Y.*

7 VALVE-STEM ALLOY—"Hancodur" self-lubricating alloy developed expressly for use in Hancock "500 Brinell" bronze valves. Maker claims repeated breakdown tests indicate new stem and bonnets outwear other stems and bonnets six times. *Hancock Valve Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn.*

8 PIPE HANGERS—Functional spring hangers and vibration eliminators, for high-pressure, high-temperature service, meet Code requirements for pressure piping. Hangers are easily installed and automatically adjusted to any location. Three types of vibration eliminators, all with double-acting spring effect, permit swivel action in all directions. Pivotal Rod Types 1, 2 and 3 are used where lateral movement is limited to the extent that carriage hangers are unnecessary. Carriage hangers, Types 4, 5, 6 and 7 permit large line movements in all directions. Multiple rolling action accommodates thermal movements of piping and permits hangers and rods to remain vertical. *Power Piping Div, Blaw-Knox Co, Pittsburgh, Pa.*

9 STEAM TRAP—Yarway impulse trap, superpressure type, is of high-pressure, flanged or welding socket end, bolted-bonnet design, with integral strainer. Working parts are similar to those in standard impulse trap. Superpressure trap designed and built for steam pressures up to 1500 lb, temperatures to 900 F. Important feature of high-pressure valve is positive closing of main valve in presence of wet, saturated or superheated steam. *Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.*

10 BUTTERFLY VALVE — Illustrated is handwheel operated design of company's improved butterfly valve in which internal parts are machined to assist operation and obtain tight fit between housing and vane. Feature in design lies in pair of adjustable stops provided



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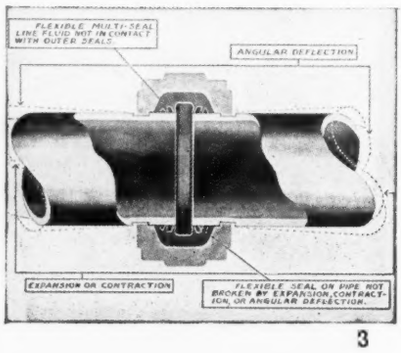
FLEXIBLE MULTI-SEAL LINE FLUID NOT IN CONTACT WITH OUTER SEALS
ANGULAR DEFLECTION
EXPANSION OR CONTRACTION
FLEXIBLE SEAL ON PIPE NOT BROKEN BY EXPANSION, CONTRACTION, OR ANGULAR DEFLECTION.
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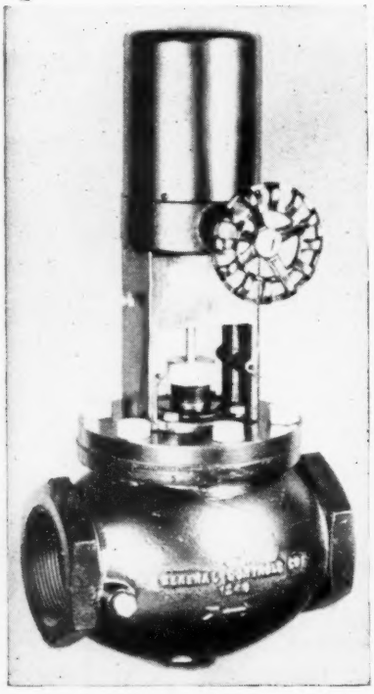
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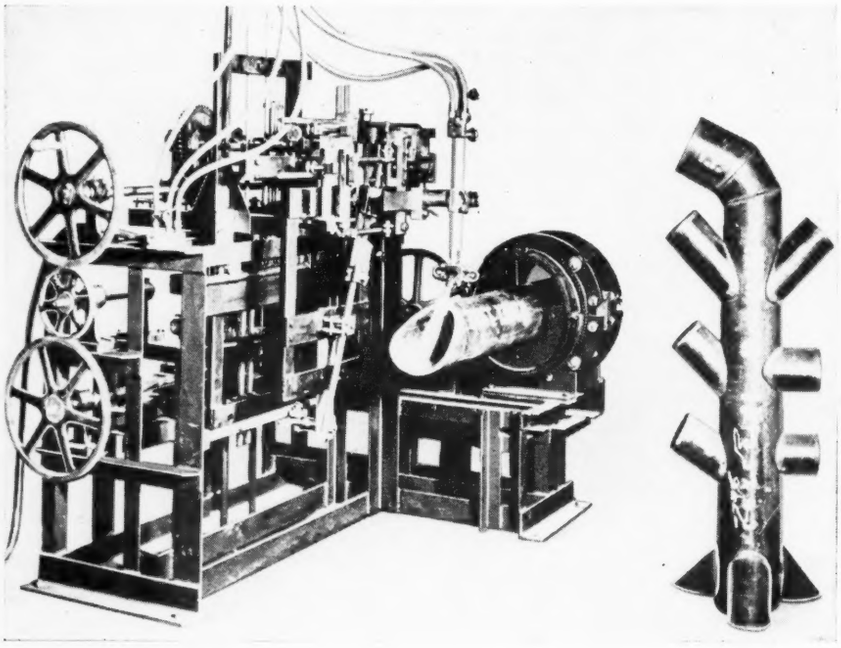
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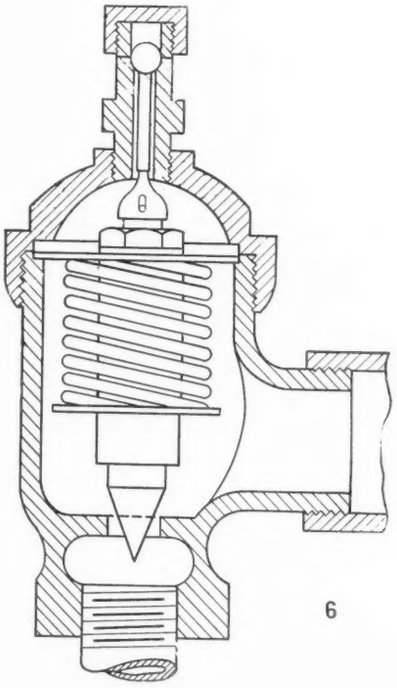
to stop vane in either of two set positions between open and closed. This permits constant duplication of any set maximum or opening, in addition to full-open and tight-closed position. *R-S Products Corp, 4530 Germantown Ave, Philadelphia, Pa.*



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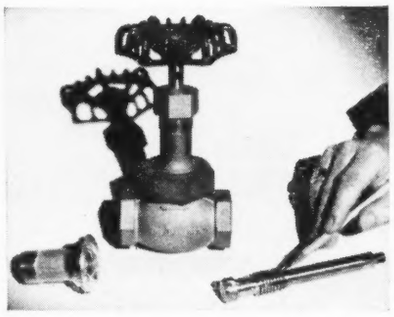

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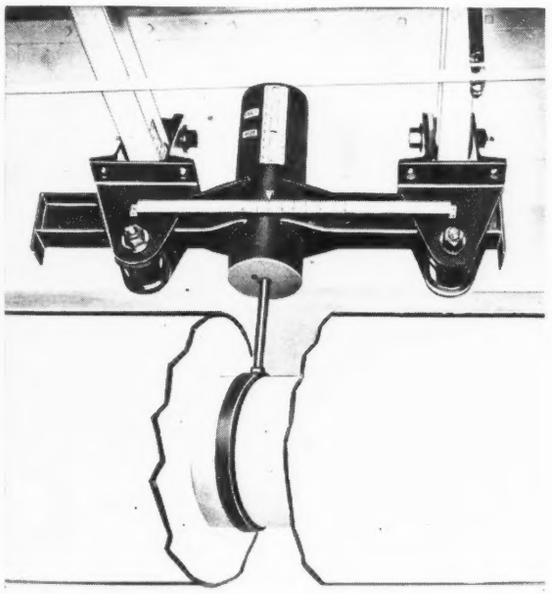

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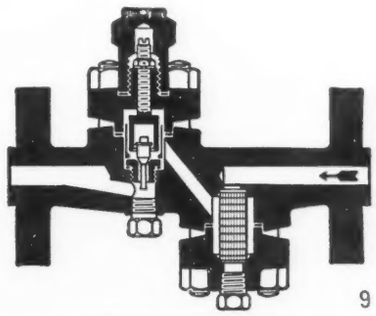
11 REDUCING ELBOW — Reducing butt-welding elbow is used where both direction and pipe size have to be changed. Formed from one piece of rolled steel by special process. Normalizing plate and weld relieves stresses set up in forming and welding operations. *Midwest Piping & Supply Co, 1450 South 2nd St, St. Louis, Mo.*

12 SAFETY CONTROL—Combined trip and throttle valve has been designed and built into Type D mechanical-drive turbine built by company. Provides overspeed protection similar to that on large central-station and industrial units. Positive protection assured because built-in valve shuts off all steam flow automatically before dangerous speed is reached. Easily accessible Monel-metal, basket-type steam strainer around trip and throttle valve prevents foreign material from entering. *General Electric Co, Schencetady, N. Y.*

HIGH PRESSURE VALVES — Atkomatic high-pressure valves, in standard line, have been supplemented with line of high-pressure valves for pressures up to 3000 lb. Units are bronze, packless, with renewable seats and disks. Seat diameters can be furnished up to full pipe size. Bubble-tight pilot assembly can be made for air or gas operation. Under certain conditions, when used on liquids, certain amount of timing control may be obtained on opening and closing speeds. *E C Atkins & Co, S Illinois St, Indianapolis, Ind.*



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SUPERPRESSURE TYPE

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SWING CHECK VALVE—Regrindable swing check valve is for 125 lb steam pressure at 500 F, or 250 lb non-shock cold oil, water or gas. Disk can be reground without removing valve from line. *Jenkins Bros, 80 White St, New York, N. Y.*

PIPE CLEANER—Cable-type pipe cleaner, operated through automatic clutch, cleans U-bends, traps, tees, elbows and gate valves, etc. Applications include cleaning condenser tubes, feedwater heaters, fire-tube boilers, water-cooled furnaces, air-conditioning units and gas, oil and chemical lines. *Pittsburgh Pipe Cleaner Co, Pittsburgh, Pa.*

GATE VALVES—Standard iron-body wedge gate valves are for 125 lb steam, 200 lb cold-working pressures. Feature of new valve is redistribution of body and bonnet materials. New line includes both brass-trimmed and all-iron patterns with O S and Y or non-rising stem, in sizes 2 to 12 in. inclusive. *Crane Co, 835 S Michigan Ave, Chicago, Ill.*

REDUCING VALVE — Relay-operated Copes pressure-reducing valve designed for remote-control service with water or steam. Actuating element is reinforced rubber diaphragm with mean effective area of 41 sq in. Relay-operating cylinder of control valve has mean effective area of 28 sq in. One side of diaphragm is open to atmosphere, while other is subjected to operating pressure from pilot of Copes master control. Any pressure change from master control pilot causes diaphragm to move. This movement is transmitted through an adjustable shaft extension and floating lever to pilot valve of relay operator. This changes pressure on one side of operating cylinder, moving valve in opposite direction. *Northern Equipment Co, Erie, Pa.*

STEAM TRAPS—Additions to line of present side-inlet traps are No. 811 in 800-1000 lb per hr capacity range; No. 812, 1600-2000 lb

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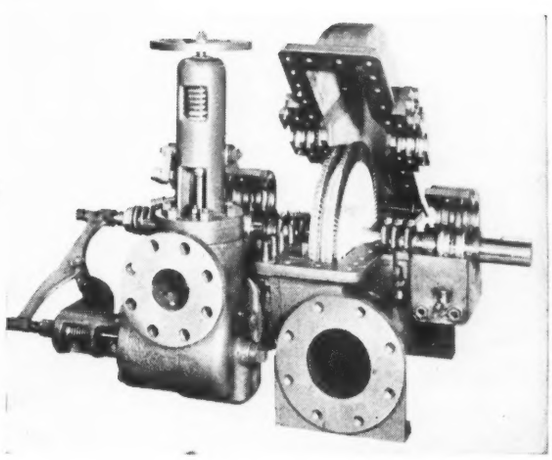

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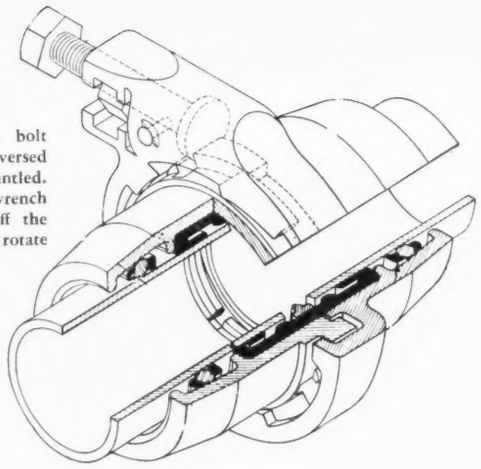
capacity; and No. 83, 3000-4400 capacity. New units built for operation on pressure up to 250 lb g, and are equipped with standard all-stainless-steel inverted-bucket operating mechanism. *Armstrong Machine Works, 812 Maple St, Three Rivers, Mich.*

PIPE SEALING COMPOUND — "Black Magic" pipe-sealing compound and gasket-sealing cement forms permanent seal in pipe joint or gasket, yet retains enough flexibility, according to maker, to permit expansion and contraction in metals without cracking. Compound said not to become brittle with age, making it particularly adaptable for use on underground piping. Comes ready to use in tube, requires no mixing, and stays at same consistency at all times. *Black Magic Products Co, P O Box 1703, Tulsa, Okla.*

BALL GRIP COUPLING—H-W ball grip coupling consists of housing with ball retainer and flexible sealing gasket. The ball retainer or cage carries a plurality of balls and a frictionally engaging means, so that after the pipe is inserted and pulled outward the balls are brought in contact with the tapered surface, causing a positive lock, preventing the pipe from being withdrawn. One bolt tightens connection and same bolt reversed automatically allows coupling to be dismantled. No special tools required, and small wrench all that is necessary to take coupling off the pipe, apply tension, and at same time rotate coupling. All couplings provided with pipe stop to assure pipe being centered in coupling. Gaskets used in new-type coupling made of either synthetic or Para rubber compounds. Coupling has flexible metallic locking action, said to combat corrosion. Balls of coupling remain in contact with both housing and pipe. Thus electrical currents can pass through easily. *Hanlon-Waters, Inc, Tulsa, Okla.*



PUMPS

POWER PUMP—(Photo directly below)—Vertical triplex single-acting plunger-type pump suits small capacity high-pressure installations. Has no gears and is specially designed for use with built-in gearhead motors, although it can be used for V-belt drives. Construction features outboard plungers, with dry joint between liquid cylinder and power frame. *Worthington Pump & Machinery Corp, Harrison, N. J.*

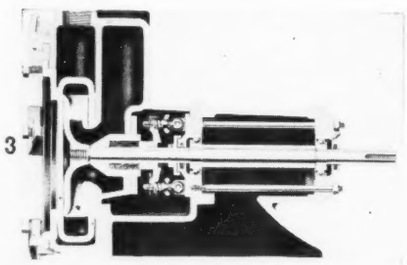
AIR PUMP—Streamlined air pump comes with ½ hp motor, and all parts for both pressure and vacuum operation. Vacuum pump is rotary operating without gears, springs or valves. *Gast Mfg Corp, Hinkley St, Benton Harbor, Mich.*

1 SUMP PUMP—Eastern pump can be used for automatic drainage or seepage, overflow, etc, from elevator or boiler pits. Float adjustment can be made by thumb screw, and completely encased toggle switch and copper float assures positive automatic action. Operated by ¼-hp, 1725-rpm, induction-type, heavy-duty, semi-inclosed Westinghouse motor. *Eastern Engineering Co, 45 Fox St, New Haven, Conn.*

2 CHEMICAL-INJECTOR PUMP—Scale is removed from boilers by pumping unit that injects chemical compounds into hot water and steam systems. Small variable-speed motor with low current-consumption operated constantly in connection with a train of gears, cams, and switches, and may be adjusted to control periodical injections. Can be also fitted with metering device which will feed fluids in proportion to other fluids. Solenoids supply power to operate pump, which has sufficient power to send liquid into a boiler against 250 lb pressure. *James Research Laboratories, Addison Rd, Chicago, Ill.*

3 PUMPS—Types A and T horizontal pumps available in capacities up to 1400 gpm, for operating heads to 100 ft. Type A is shown, while Type T is similar in design except that intake opening is horizontal and concentric with shaft. American Manganese Steel Div. *American Brake Shoe and Foundry Co, Chicago Heights, Ill.*

4 CENTRIFUGAL PUMP—Line of Westco centrifugal pumps marks company's entry into centrifugal pump field. Streamline pumps are available as flexible coupling drive models, and Uni-Bilt models, illustrated. Heavy close-grained cast-iron torpedo type frame absorbs



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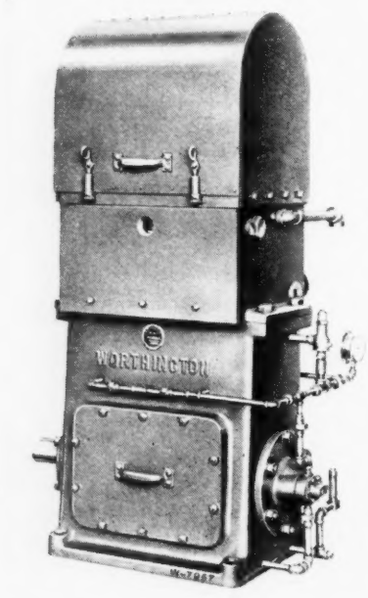

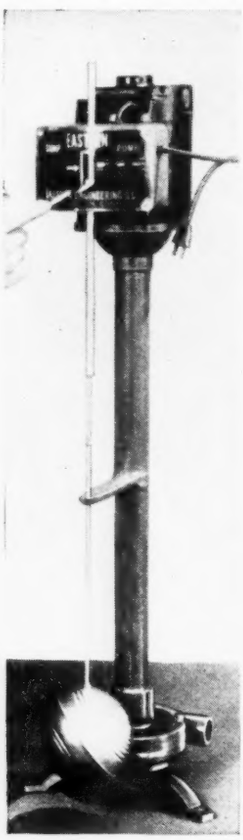

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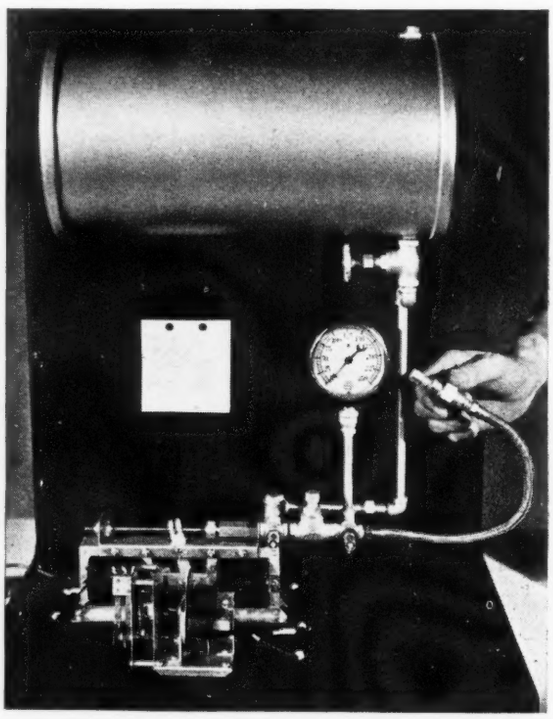

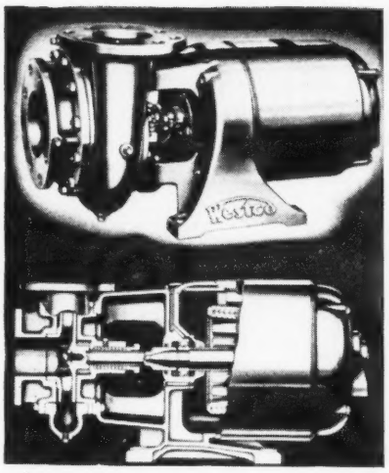

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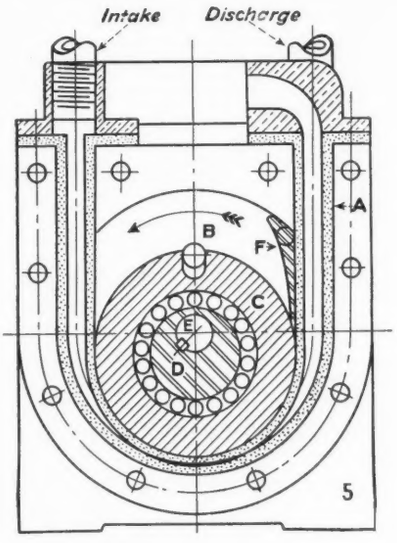

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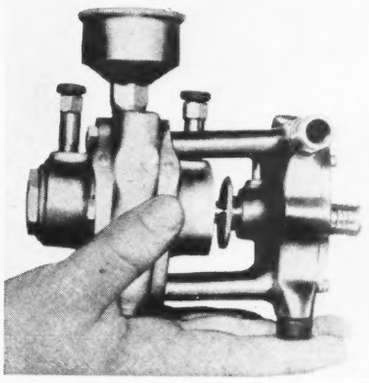
operating strain and guards against misalignment, while suction cover is ribbed to withstand distortion. *Micro-Westco, Inc, Bettendorf, Iowa.*

5 VACUUM PRESSURE PUMP—In operation, drive shaft *E* rotates in direction indicated by arrow. Rotor *D*, being off center, pushes compressor ring *C* against tube *A*, a distance equal to inside diameter of tube, closing it, as shown in drawing. This action moves along from intake to discharge side. Tube guide plate *F* and pump casings *B*, prevent tube while under pressure, from expanding beyond normal diameter. *Huber Pump Div, Downingtown, Pa.*

6 AIR-POWERED PUMP—Model D, air-powered midget pump can be used in all industrial, laboratory and experimenting applications where an explosion-proof unit is necessary and where compressed air is available. Pump impeller is mounted on end of motor countershaft, making coupling unnecessary. *Eastern Engineering Co, New Haven, Conn.*

7 CENTRIFUGAL PUMPS—Type SV centrifugal pumps can be used for extremely high, as well as sub-zero temperatures, handling both heavy and light liquids. Pumps supplied for cold service are foot mounted, as in upper photo, and pumps for hot service are centerlined mounted. *Pacific Pump Works, Huntington Park, Calif.*

8 ROTARY PUMP—Rotary coolant and transfer pump differs from most vane pumps in not depending on either springs or centrifugal force to keep vanes in effective spanning position. This is accomplished by ring-assembly elements of hardened steel that engage underside of tempered vanes and maintain latter in correct position. *Eddington Metal Specialty Co, Eddington, Pa.*



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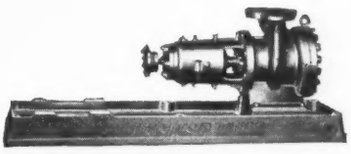

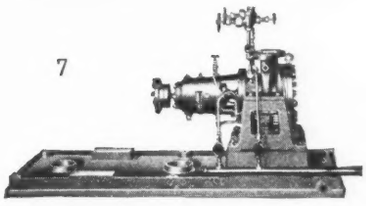

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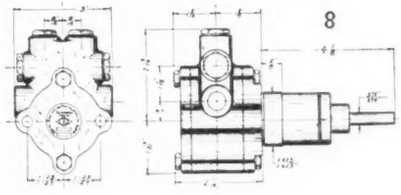

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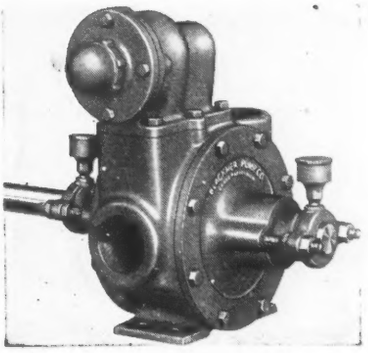
9 ROTARY PUMP—Blackmer pump employs basic bucket design and operates on same principle as all Blackmer pumps, but has certain refinements which are said to increase efficiency and bucket life. Standard units furnished as single or twin pumps, with single-reduction-gear-drive or a single pump direct-connected to gearhead motor. *Blackmer Pump Co, Grand Rapids, Mich.*

10 PLASTIC PUMP—Machined from solid block of Plexiglas, crystal clear plastic material, pump can be used for handling dilute acid, hypochlorites and other chemicals. Feature of pump is visibility at all times of liquid flow and movement of valve checks and pump piston. *Milton Roy, 1305 E Mermaid Ave, Philadelphia, Pa.*

11 PUMP HEAD—Gearturbo pump head has several improvements in 1941 models, including change in bearing application. Head assembly is streamlined and gearing is completely housed for weather protection. *Peerless Pump Co, 301 West Ave 26, Los Angeles, Calif.*

CHEMICAL PUMP—Nelson Chemical proportioning pump (original description p 142, February, 1940, POWER) has several improvements, based on data obtained from users of pumps in the field. Arrangement of inlet and outlet valves on feeding end of pump have been changed to decrease friction losses and lend pump a greater volumetric efficiency. Several other changes also made. *D W Haering Co, Inc, 2308 So Winchester Ave, Chicago, Ill.*



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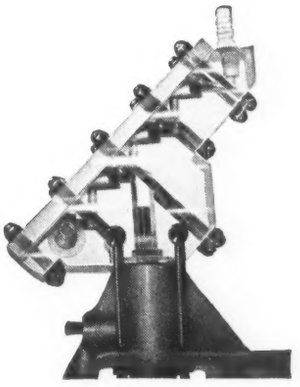

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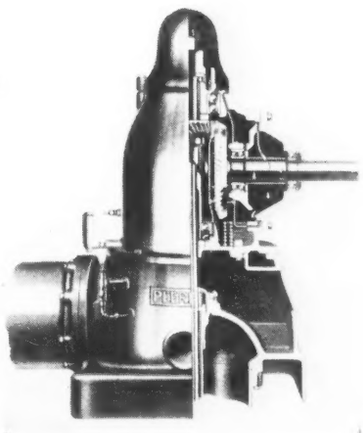

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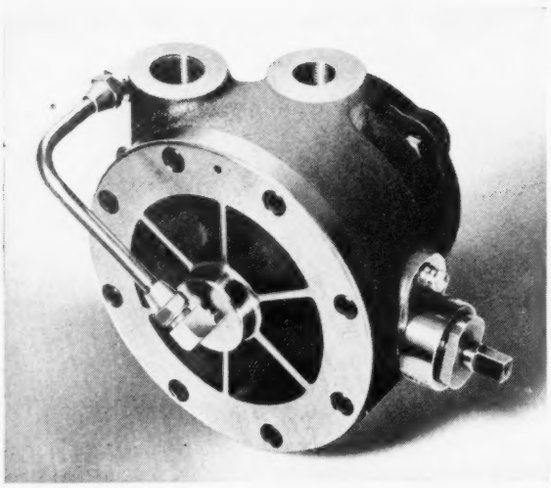
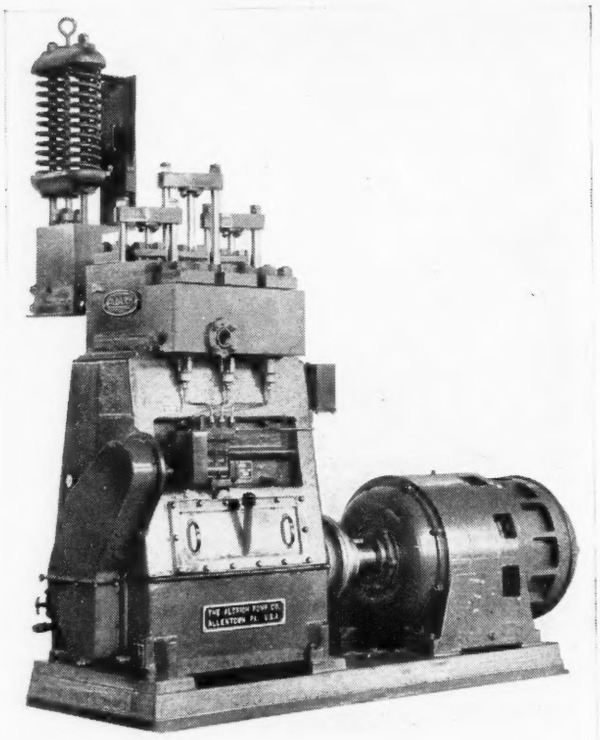
EXPLOSION-PROOF PUMP—Newest addition to line of miniature pumps bears Underwriters Class I, Group D label of approval. Maximum capacity is 5.7 gpm, with a maximum pressure of 16 lb psi. *Eastern Engineering Co, 45 Fox St, New Haven, Conn.*

TURBINE PUMP—Design improvements in company's line of vertical-turbine pumps include changes in guide vanes, function of which is to alter from horizontal to vertical, flow direction of liquids being pumped. With advance ends bulbous shape, it was found that, regardless of fluid direction from impeller direction would always be substantially tangential to vane surface. *Pomona Pump Co, Pomona, Calif.*

GLASS PUMP—Nash pump, developed in 1940, now made in smaller size; ¾ x 1 in, with 10

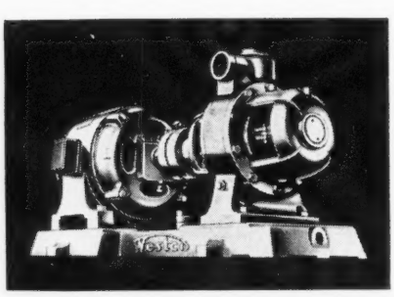




gpm capacity. Like larger pumps, new size is actually constructed of Pyrex glass and has same advantages of larger pumps. *Nash Engineering Co, So Norwalk, Conn.*

VANE-TYPE PUMP—(Above, left)—Balanced vane-type pump for oil-hydraulic operation and for working pressures up to 1250 lb announced. Available in range of from 0 to 8 gpm, it is reecommended where operating conditions involve line surges. Each one of dual vanes is bevelled around its entire edge so that oil from the oil hole in the rotor can flow all around the edges. Increasing or decreasing rate of delivery is accomplished by means of an adjustment screw and can be done while pump is operating. Delivery is infinitely variable over the range. *Detroit Universal Duplicator Co, Detroit, Mich.*

TRIPLEX POWER PUMP—(Above, right)—High-pressure vertical triplex constant-stroke pumps are in sizes from 10 to 150 hp, for pressures up to 9800 lb per sq in., and capacities up to 220 gpm. Improved design said to make pump applicable to gearhead motor or speed-reducer drive. Provision made in larger sizes for use of built-in gearing, or belt drive direct to crankshaft. Pumps can be fitted with Aldrich patented synchronized suction-valve control, as shown, for services such as central hydraulic accumulator systems where several units are in constant operation. For special process work at the high pressures encountered in oil refining and chemical industries the outboard plungers are sealed dust and weather tight with a removable cover. *Aldrich Pump Co, Allentown, Pa.*



TURBINE PUMPS—(Photo at right)—Westco turbine pumps announced in new series featuring renewable liner. This liner minimizes shut-down losses and production delays, for the liners, forming liquid channel within the unit, can be replaced. Pump capacity can also be altered. This alteration can be accomplished in the field without disturbing the suction lines, simply by replacing the liners with a different set. Illustration shows exterior view of pump. *Micro-Westco, Inc, Bettendorf, Iowa.*

WELDING

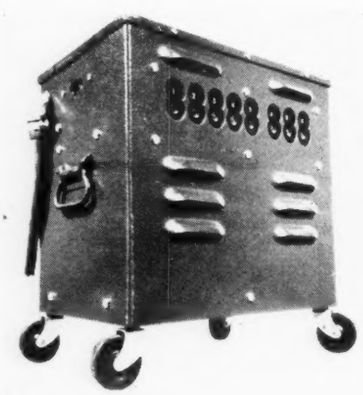
WELDING ELECTRODE — Murex Alternex electrode is designed for use with transformer-type ac welding equipment, and handles well in all positions, including vertical-down-welding. *Metal and Thermit Corp, 120 Broadway, New York, N. Y.*

WELDING TRAILER—Pneumatic-tired trailer to mount all company electric-drive welders announced. Unit is so designed that welder mounting is easily accomplished by four bolts in trailer frame which register with four holes in leg of welding machine. *Hobart Bros Co Troy, Obio.*

ELECTRODE SELECTOR—Slide-rule-type selector reads directly length of arc-welded joints obtainable for 100 lb of electrode, also pounds of weld metal deposited per 100 lb of electrode. *General Electric Co, Schenectady, N. Y.*

1 WELDER—Midget marvel Flexarc welder is for welding light-gage metal and castings, general maintenance and production work. Sensitive adjustment of welding current over a range from 20 to 140 amp provided by 15 steps with correctly proportioned increments between. *Westinghouse Elec & Mfg Co, East Pittsburgh, Pa.*

2 ARC WELDER—Standard welder is for 230-volt, 60-cycle operation. Fifteen different welding heats provided, between 20 and 175 amp. Penetration may be up to ¼ in. or



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Power Man Heads ASME

POWER MEN EVERYWHERE are honored this year by the election of James W Parker as new president of the ASME. Vice president and chief engineer of The Detroit Edison Company, Mr. Parker is widely known and has contributed notably to the advance of power-plant practice. He is a mechanical engineering graduate of Cornell University and honorary master of science of the Detroit Institute of Technology.

After apprentice work with power and street railway companies, Mr Parker became boiler-room engineer with Detroit Edison in 1910. For the past twenty years he has organized and directed the various engineering projects of his company, notably the design and construction of Trenton Channel power plant, Marysville, Delray No 3 and Conners Creek. He has also had general responsibility for the operation of the Detroit Edison electrical system and its generating plants and central-heating plants and systems. He has served as president of the Engineering Society of Detroit and has long been prominent in the ASME.

In addition to the president, four vice presidents and three managers have been elected. Of these the man best known to power engineers is Manager W G Christy, smoke abatement engineer of Hudson County, N. J. Graduated from Cornell (ME) in 1911, Mr Christy did early work for the Heine Boiler Co and later did a variety of power-plant and construction work in the St Louis area.

James W Parker, new ASME president, is vice-president and chief engineer of Detroit Edison Co—builder of notable power plants.

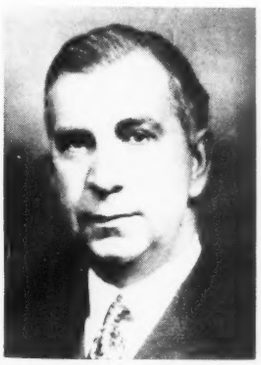
Mr Christy is best known for his accomplishment in the field of smoke abatement. In 1926 he became secretary of a citizens' committee to combat smoke in St Louis, which undertook one of the most comprehensive smoke campaigns in the United States. Because of this good work he was called to Hudson County in 1930 to organize smoke abatement there, with an ultimate success of 90 per cent reduction of the smoke nuisance. Mr Christy has been active in ASME since 1919.

The remaining new vice presidents and managers are outstanding men in other fields than power. Here's who they are in brief.

Vice President—Clarke F Freeman: senior vice president, R. I. Manufactur-

(*Continued on page* 92)

C F Freeman
Vice President



W H Winterrowd
Vice President

C B Peck
Vice President

W R Woolrich
Vice President

Masters of Metal

Scovill

MANUFACTURING COMPANY

WATERBURY, CONN.

installs 225,000 lb./hr.

Organized in 1802, Scovill Manufacturing Company is not only an outstanding but the oldest of American brass manufacturers. In the power plant field, Scovill Manufacturing Company is especially well known for the excellence of their condenser tubes as well as condenser tube engineering service.

The new Riley Steam Generating Unit and topping turbine are a natural climax to nearly a century and a half of industrial power at Scovill. The new Riley Unit, operating at 725 pounds drum pressure and 750°F. total steam temperature supplies steam for a new 5000 K.W. turbine which exhausts at 250 pounds to existing turbines.

The new Riley Unit consists of a 4-drum Riley Boiler, Riley Superheater, Riley Air Heater, Riley complete Water-cooled Furnace, enclosed in a Riley Steel-clad Insulated Setting fired by Riley Pulverizers and Burners.

Characteristically Riley, here is another plant where a Riley Steam Generating Unit was placed on the line and operated very satisfactorily right from the start, with efficiencies higher than guarantees. The following table of comparable results indicates clearly that invariably Riley gives you more than your money's worth and that you can rely on Riley.

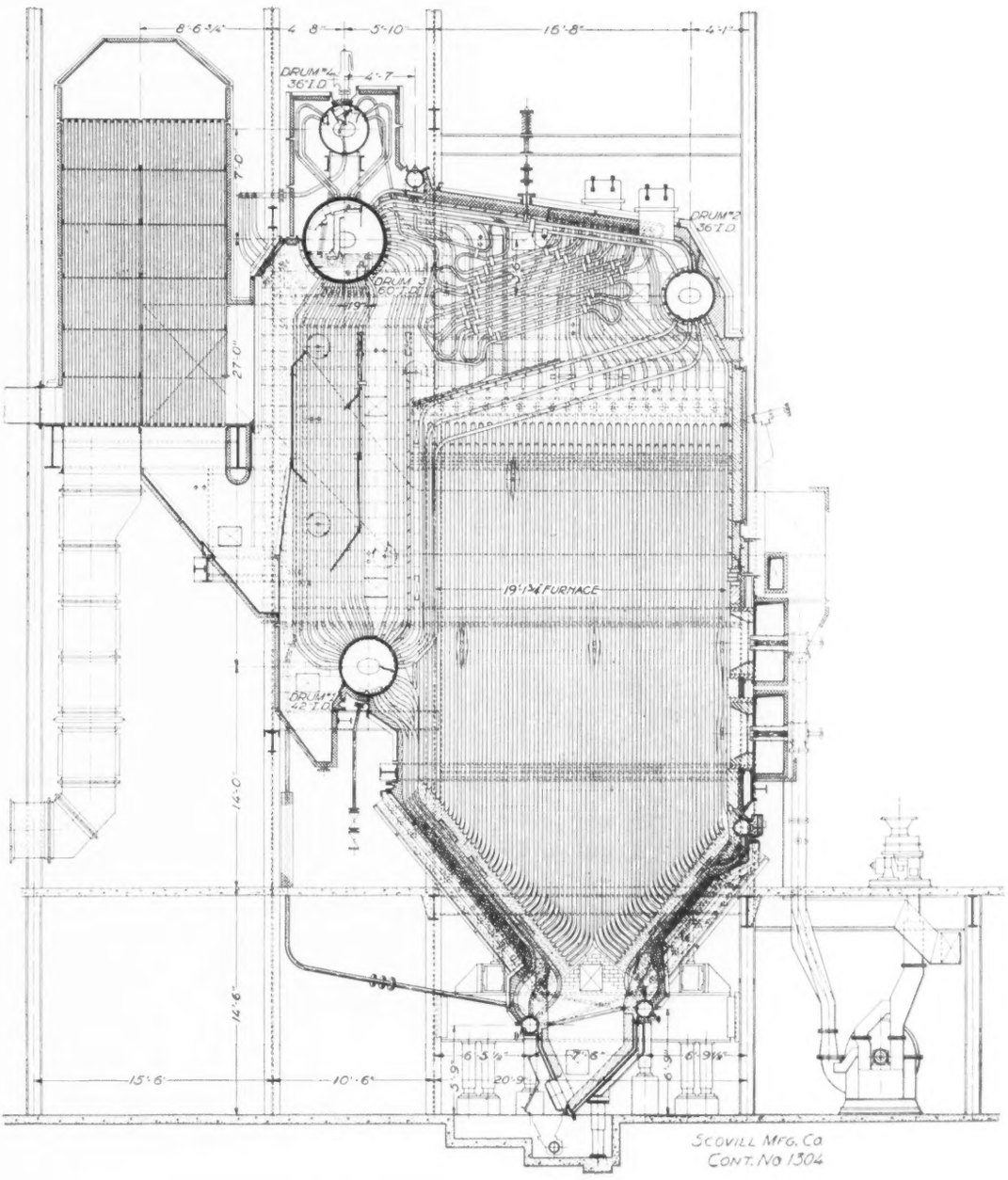
LBS. OF STEAM PER HOUR	200,000	205,975
	Guaranteed	Actual
Total Steam Temperature	750°F.	750°F.
Temp. Gas Leaving Boiler	735°F.	729°F.
Temp. Gas Leaving Air Heater	390°F.	391°F.
Temp. Air Entering Air Heater	80°F.	99°F.
Temp. Air Leaving Air Heater	535°F.	545°F.
Air Press. Ent. Air Heater	5.0"	4.6"
Air Press. at Burners	1.7"	1.2"
Draft at Boiler Outlet	-3.4"	-1.4"
Draft at Air Heater Outlet	-5.0"	-2.2"
Efficiency	85.8%	87.16%

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

RILEY STEAM GENERATING UNIT



SCOVILL MFG. CO., Waterbury, Conn.

225,000 lbs./hr. Riley Pulverized Coal Fired Steam Generating Unit. 725 pounds pressure. 750° F. Steam Temperature. Furnace Depth—19′ 1¾″ Furnace Width—19′ 6″ Unit consists of Riley Boiler, Superheater, Water-cooled Furnace, Air Heater and Steel-clad Insulated Setting fired by Riley Pulverizers and Burners

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

ASME Highlights—Personalities and Awards

ers Mutual Fire Insurance Co and associated companies, son of famous John R Freeman. Early work in scientific management. World-war engineer in U S Ordnance Dept.

Vice President—Clair B Peck: managing editor, *Railway Mechanical Engineer*. Early practical mechanical engineering experience on railroads. In railway editorial work on various publications since 1914.

Vice President—W H Winterrowd: Vice president, charge of operations, Baldwin Locomotive Works, Eddystone, Pa. Mechanical engineering at Purdue University.

(As this goes to press, we learn that Mr. Winterrowd died Dec. 8 from injuries received in an automobile accident. Ed.)

Vice President—W R Woolrich: Dean, College of Engineering, University of Texas. Early plant experience. Electrical graduate of University of Wisconsin (later ME). Many years of industrial and educational work.

Manager—Herbert L Eggleston: Manager of gas and refining departments, Gilmore Oil Co, Los Angeles. Graduate Sheffield Scientific School, Yale. Worked up in the operating end of oil refining.

Manager—Thomas S McEwan: consulting management engineer, Chicago. Cornell graduate in mechanical engineering. Long experience in engineering sales and management.

Of particular interest to POWER readers was the selection of D Robert Yarnall, president of the Yarnall-Waring Company, as the fifth recipient of the Hoover Medal. Presentation was at the Annual Dinner. Details of Mr Yarnall's career were outlined on page 170 of December POWER, and brought to many readers an insight into his humanitarian activities. The citation read:

Bachrach photo

Hoover Medalist: D Robert Yarnall

"D Robert Yarnall, humanitarian, engineer, and a leader in the engineering profession, who rendered an outstanding service as a member of a mission that fed the children of Germany at the end of the World War and that is now aiding refugees in this country and Europe, and providing food and relief for the children and mothers of France. These distinguished public services have won for him the Hoover Medal for 1941."

Awards and honors with a national-defense slant were honorary memberships to Honorable Clarence D Howe, Canadian Minister of Munitions and Supply; Rear Admiral Samuel M Robinson, Chief of Bureau of Engineering, U S Navy; Major General Charles M Wesson, U S Army—also award of the Holley Medal to John C Garand, (Springfield Armory), inventor of the Garand Rifle; of the ASME Medal to Prof Theodor von Karman, director of the Guggenheim Aeronautic Laboratory, California Institute of Technology; of the Worcester Reed Warner Medal to Richard V Southwell, professor of Engineering Science, Oxford University, for work in aeronautics and other engineering fields.

At the Annual Dinner and Honors Night, retiring president William A Hanley delivered the presidential address "America Must Decide." Donald M Nelson spoke on "Whither Industry—In Democracy's Arsenal."

Other awards included the Melville Medal to R V Terry of Newport News, Va, for his paper "Development of the Automatic Adjustable-Blade Type Propeller Turbine." John T Rettaliatta of West Allis, Wis, won the Junior Award for his paper "Combustion Gas Turbine." The Pi Tau Sigma Medal went to R H Norris of Schenectady for outstanding achievement in mechanical engineering (heat transfer), and the Gantt Medal to Paul E Holden, Stanford University.

T S McEwan
Manager

W G Christy
Manager

H L Eggleston
Manager

In the ten pages that follow will be found digests of power papers and pertinent discussions presented at the Annual Meeting of the American Society of Mechanical Engineers

Mercury Power Wins its Spurs

► THE HISTORY OF THE MERCURY-VAPOR process was reviewed by H N Hackett and in a longer paper by A R Smith and E S Thompson, all of the General Electric Co. Following is a summary of Mr Hackett's paper:

In the mercury-steam binary-vapor power cycle, vapor from the mercury boiler drives the mercury turbine. This exhausts to a mercury condenser which is likewise a steam boiler, producing steam for turbine operation or any other purpose. The economy of such a process is plain when it is considered that the power is generated in two turbines with only the boiler wastes and condenser loss that is normally accepted with a steam turbine alone.

Thermal efficiencies of the binary cycle have reached 37 percent and may some day exceed 50 percent. Mercury as a medium for the generation of light, heat and power, was first experimentally tested by General Electric in 1912.

Troubles with Mercury

Early experiment seemed to indicate that mercury was practically inactive to iron and steel. As time went on, and larger boilers were built, it was found that mercury slowly dissolved iron from the inside walls of the tubes and redeposited it in cooler regions, plugging the tubes at their upper end. Overheating occurred because of restricted circulation.

The full importance of these difficulties was not appreciated until after two 20,000-kw units—one at Schenectady and the other in the Kearny generating station of Public Service Gas & Electric Co (New Jersey)—had been placed in service in 1932 and 1933, respectively.

Shortly after the Kearny unit had been placed in operation examination of the tubes indicated serious overheating from inside deposits of iron oxide combined with mercury particles.

Complete solution of this trouble came as a result of an extremely active research program in which the metallurgical and chemical properties of mercury, combined with other metals, were thoroughly studied. General Electric scientists and chemists suspended weighted pieces of polished steel in mercury amalgam in hundreds of small "harp" boilers. Extraordinary results were obtained in one harp boiler containing a certain dilute mercury-sodium-titanium amalgam. This wetted the steel completely, yet did not dissolve it.

Cure Discovered

In March, 1934, one part of sodium was added to 10,000 parts of mercury in the Kearny boiler. Before the sodium was added the boiler could carry only 20 percent of full load without overheating. Shortly after the load was increased to 100 percent, which load was subsequently carried continuously for three months. No titanium was added to the mercury.

Later troubles were encountered due to deposits of mercury mechanically mixed with sodium ferrite. Oxygen was found to be the cause. New centrifugal seals were devised for the turbine shaft and welded joints were made doubly tight. Air infiltration was thereby reduced from 500 cu ft per hr to less than 1 cu ft.

Later it was found that magnesium and titanium had all the advantages of sodium and titanium, and none of the undesirable features, so the change was made.

Early in 1939 an entirely new boiler, embodying all the developments so painstakingly discovered, was placed in operation by Babcock & Wilcox in the Marcus Hook Refinery of the Sun Oil Co. This generated vapor for processing lubricating oils. Its complete success made it appear that sufficient knowledge was at last available to expect predicted results.

Thereupon the Kearny unit was rebuilt. The new mercury boiler followed conventional steam-boiler design and embodied results of all the experience gained at Schenectady, Marcus Hook and Pittsfield. Simple through-type mercury circuits were employed, using fog-type convection surface to the limits of existing experience. Of the 24,407 sq ft of mercury heating surface 71% was of the fog type, which is empty of liquid mercury at starting.

The octagonal furnace is approximately 26 x 28½ ft by 50 ft high inside. All the furnace tubes are relatively small. These tubes operate at a metal temperature between 1050 and 1180 F, and at pressures ranging from 140 lb gage at the drum to 395 lb at the lower header (difference due to hydrostatic load of mercury). The boiler contains 310,000 lb of mercury.

The unit went into service in May, 1940, and has operated almost continuously since at 20,000 to 21,000 kw, either coal- or oil-fired, generating power at 9200 Btu per net kwhr, the lowest heat rate in history, with only two short outages caused by equipment failures. The normal rated output of the unit is 21,000 kw from the mercury-turbine generator, and about 30,000 kw from the by-product 365-lb-gage steam produced.

The operation of this new unit is very simple, requires no more attention from the operator than similar steam equipment. In fact, the mercury-vapor plant is the most reliable unit on the Public Service system. Mercury at Kearny now produces one net kilowatt-hour for 0.5 lb of fuel oil.

Details by Smith and Thompson

Much of the same ground, but in greater technical detail, was covered in the 18-page paper by A R Smith and E S Thompson. Following is a brief summary of certain portions. (For other details on Kearny see pages 57, 64, 65, 66, 67 of POWER, April, 1941).

The convection surface of the boiler is empty when cold, but, in service is filled with mercury "fog" (mixture of liquid and vapor, mostly vapor). The design of this boiler, insofar as the functioning of the mercury is concerned, was by General Electric Co. The mechanical design, combustion facilities, and building and erection were done by the Babcock & Wilcox Co.

Between May 6, 1940, and Feb 1,

1941, the plant had produced 103,540,000 kw hr from the mercury steam turbine generator and 1,505,232,000 lb of steam.

All the mercury units built so far have been "topping" units. A mercury top can be placed on any steam plant. With mercury superposed over 600-lb 730 F steam, 7250 kw may be generated for 100,000 lb of steam produced in the condenser boiler, whereas a superposed steam turbine at 1200 lb 925 F can generate only 1960 kw per 100,000 lb of steam.

Industries requiring steam for process work at any pressure and temperature will find that the mercury plant furnishes an economical means of supplying the steam, with greater amounts of by-product power available than can be furnished by any other power cycle.

Wind-tunnel Tests for Stacks

The Consolidated Gas Electric Light & Power Co is now erecting its new Riverside steam-electric station near Baltimore, Md. Because of the proximity of the municipal airport, it was important to keep stack height as low as possible. Stack height was not needed for draft.

To settle the matter of "best" height, the company conducted an elaborate series of smoke tests of plant models in a 7-ft wind tunnel. The work was described in a paper by H L vonHohenleiten and E F Wolf, both of Consolidated.

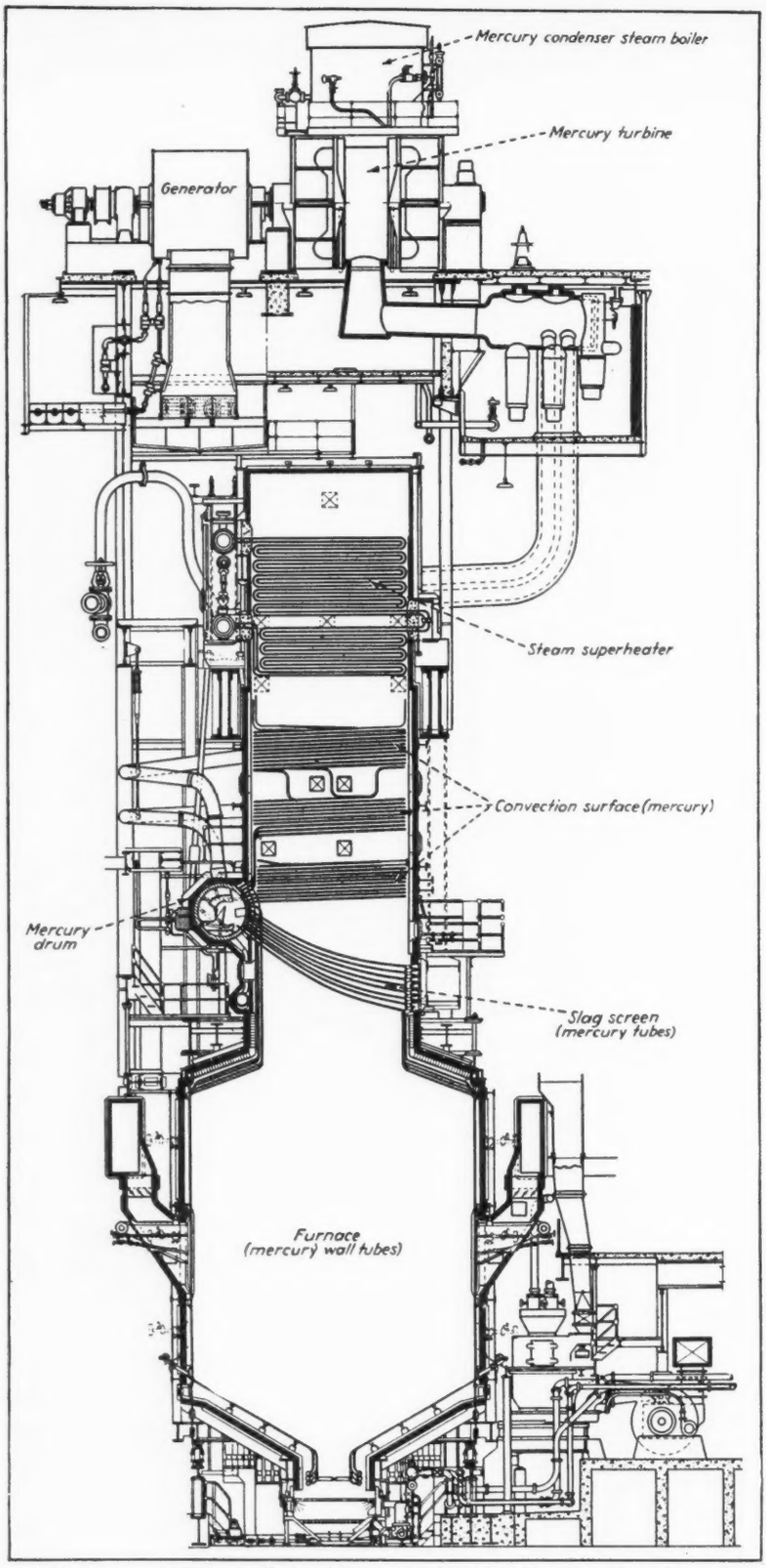
Ammonium chloride was used to simulate smoke. Experiments were conducted over the entire range of wind velocities and directions, for various heights of stack—also with additional stacks representing future growth of the plant. Tests were also made to show the effect of various wind shields and obstacles.

As would be expected, the amount of downdraft was found to diminish with increasing stack height. The stack height had to be at 1.31 times the height of the boiler-room monitor to reduce the smoke nuisance to reasonable limits with a 20-mile wind. The authors warned against applying the specific results obtained at this plant to other installations. However the test procedure should be useful anywhere.

Designing Drip Drains

For years it has been customary to "cascade" hot drips from a feedwater heater operating at a higher pressure to one operating at a lower, thus conserving the heat in the flashed steam.

Because of flashing it is difficult to design piping for these drains, and many of them have given trouble.



Improved mercury boiler installed at Kearny Station in 1940 approaches closer to steam boiler design and has made notable record for reliability

In an attempt to substitute knowledge for guesswork in this field, tests and studies were made by M W Benjamin and J G Miller, both of Detroit Edison. Their findings were reported in the paper "Flow of a Flashing Mixture of Water and Steam Through Pipes."

Oswego in January

An important power-session paper on the original features of the 160,000-kw Oswego steam station (by N R Gibson and H M Cushing) will be abstracted in the January issue of POWER.

Pump Performance Highlights Hydraulic Session

▶ Of the seven papers presented at the power-hydraulic and the two hydraulic sessions, five papers were on pumps for different types of applications. J D Scoville compared the hydraulic characteristics of the fixed-blade and adjustable-blade propeller-type pumps, with particular reference to a large unit of the latter type built in this country and installed in Brazil.

A comparison between the adjustable-blade-propeller pump and the fixed-blade axial-flow type is quite similar to that between Kaplan and propeller-type turbines. A Kaplan turbine can deliver power at high efficiency over a wide range of discharge at normal head, while at low heads its output can be substantially increased over that of the propeller turbine by opening its blades. The fixed-blade propeller unit is at a considerable disadvantage in efficiency at variable flow.

Adjustable-Blade Pumps

With the adjustable-blade pump operating at constant head its discharge may be reduced by decreasing the blade pitch while maintaining high efficiency, and proportionately reducing power input. At low heads increased discharge is possible up to the capacity of the motor by an opposite change in blade angle. With a fixed-vane constant-speed propeller pump, a variable quantity at constant head can be delivered only by means of throttling on the discharge side. As a result, horsepower input is no less than at full discharge and often is substantially more. At reduced head the discharge of the fixed-blade pump is determined by its inherent characteristics and cannot be increased, as can the adjustable-blade type.

Fig. 2 shows the comparative performance of a fixed-blade and an adjustable-blade impeller of the same diameter and speed. Their specific speed is 14,000 on a gpm basis. For a constant head the curves show that power for the adjustable-blade design decreases as flow diminishes. In order to pump less than rated capacity with the fixed-blade pump the discharge must be throttled, thereby increasing the head on the pump as, for instance, to 295% at 20% discharge, but the motor horsepower goes up to 220%. If a mixed-flow pump of about one-half the specific speed were used, the head at 20% discharge would be about 160%, and the horsepower 105%. The adjustable-blade pump has a decided advantage at low flow over both types, about 25% horsepower being required at 20% discharge.

At low head it is possible to obtain higher discharge than with the fixed-blade design, as indicated, 19% at 25% head, and yet keep within the motor rating. At normal head, more than rated discharge is possible temporarily by overloading the motor.

Pumps of this new type have been used for handling pulp stock in paper mills, pumping condenser cooling water for steam turbines, and for flood-control work. Of special interest is a unit built for the Traicao plant of the Sao Paulo Tramway Light & Power Co in Brazil. This unit is one of two in series that pumps water through a head of about 100 ft for use in a hydro-electric plant that operates under a 2400-ft head.

Pump Capacity

Of special interest is the large capacity of this unit, namely, 2780 cfs at 24.6 head, and 3070 cfs at 14.8-ft head. These figures correspond to 15,000 specific speed at high head, and 23,000 at the low head. However, the horsepower capacity of the motor limits the available output of the pump. Fig. 1 shows

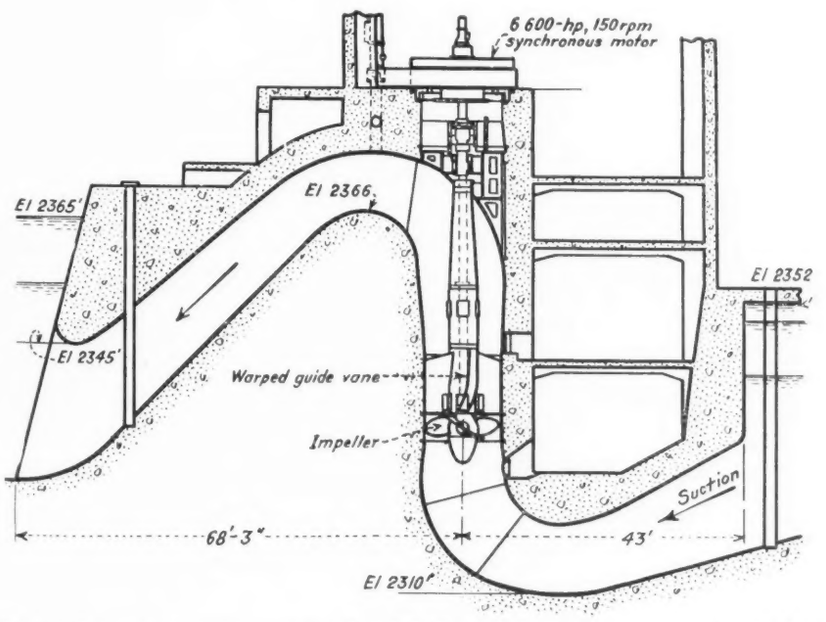


Fig. 1—General arrangement of adjustable-blade propeller-type pump installed at Traicao hydroelectric pumped-storage plant near Sao Paulo Brazil

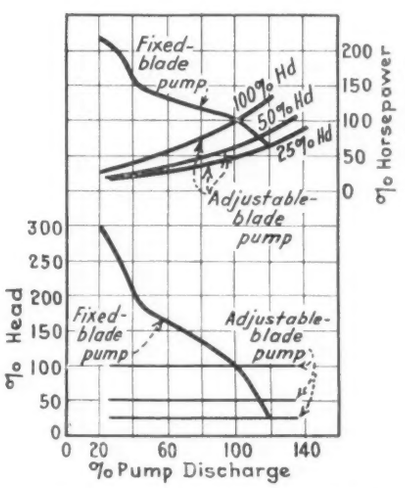


Fig. 2—Comparison of fixed- and adjustable-blade propeller-type pumps

the general arrangement of the pump. Water enters the suction tube, passes through the impeller and through a set of warped guide vanes in the discharge tube. It will be seen that the discharge tube acts as a siphon, the lower part of the invert being slightly above the maximum discharge water level. This pump is driven by a 6600-hp 3-phase, 60-cycle, 150-rpm synchronous motor with a pressure-lubricated thrust bearing for easy starting. It is expected that the pump will develop an efficiency of 80% or higher over a large part f its operating range.

Grand Coulee Pumps

Tests made on a wicket-gate pump-turbine model at the Newport News Shipbuilding & Dry Dock Co hydraulic laboratory and at the California Institute of Technology was the subject of a paper by R V Terry and F E Jaski. The model, a horizontal single-suction type, was designed to be used in a study of pumps including volute and double-volute types suitable for the proposed conditions at the Grand Coulee pumping plant. It is expected that the Grand Coulee pumps will operate under a 367-ft maximum dynamic head and have a discharge of 1,000 cfs with 5-ft positive inlet head. At a dynamic head of 295 ft their discharge will be 1600 cfs with an 80-ft inlet positive head.

Model-Runner Diameter

A runner diameter of 14.75 in. was selected which is about 22% larger than required for a normal turbine and about 5% smaller than for a normal volute pump. The eye design was dictated by the pump requirements for high efficiency and was somewhat smaller than for a normal turbine. Throughout the design, its functions as a pump were favored because of the somewhat critical conditions imposed by deceleration in the water passages, as opposed to acceleration in a turbine which is not as critical. Many previous studies by the author and others have shown that the usual pump proportions result in a fairly satisfactory turbine performance, but that the usual turbine proportions do not necessarily make a satisfactory pump.

Fig. 3 shows the estimated pump-performance curves for Grand Coulee conditions deduced from model tests at the California Institute of Technology. The head curve with adjustable wicket gates is much steeper than with gates fixed at best gate position. Brake-horsepower input to the pump is much lower for adjustable gates at the lower discharges, and horsepower at shutoff is less than one-half that required with fixed guide vanes. Efficiency gain at the lower discharges is as much as 20% with adjustable gates. Over the operating range the gain in efficiency is mainly due to the higher head obtained with adjustable gates.

Fig. 4 shows the corresponding estimated turbine-performance curves for Grand Coulee conditions obtained from

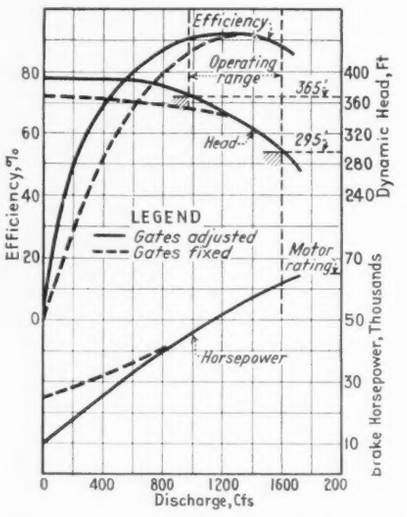


Fig. 3 — Expected pump performance curve for Grand Coulee conditions stepped up from model tests

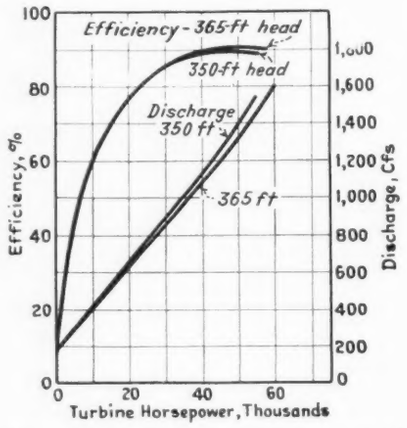


Fig. 4—Estimated performance curves of Grand Coulee proposed pumps when operated as turbines

the California test. Over the range of head from 350 to 365 ft an output of 55,000 to 60,000 hp would be obtained when operating the unit as a turbine.

Southwark Pumps

Hydraulic-engineering problems at the new Southwark generating station of the Philadelphia Electric Co were the subject of a paper by S Logan Kerr and Stanley Moyer. Initial installation in this plant will consist of two cross-compound, two-cylinder 168,750-kw, 0.90-power-factor units. The 3600-rpm, single-flow, high-pressure turbine element drives an 81,250-kva generator. The low-pressure element operates at 1800 rpm, double-flow, and drives a 106,250-kva generator. These ratings are continuous at normal hydrogen pressure. Together, the turbine elements are capable of developing 187,500 kw and each low-pressure-unit condenser has a total surface of 77,000 sq ft.

Total water requirements for condensing alone are 146,000 gpm for each unit. An additional 8,000 gpm per machine is needed to supply the hydrogen and turbine-bearing oil coolers. Conditions at this plant are such that the most economical place to locate the condenser circulating-water pumps is at the end of the coal pier, 650 ft from the condensers, as in Figs 5 and 6.

Special Tests

Since intake conditions have a very marked effect on propeller-pump performance, as well as on axial-flow and centrifugal pumps, it was decided to require the manufacturer to conduct special tests in his own laboratory on a model unit similar to the full-scale pump and under all conditions of head, discharge at inlet level. To insure that all features of hydraulic design of the pumping unit will be suitable for the Southwark conditions the pump manufacturer must complete all model tests which must be approved by the company before the pumps can be built.

When selecting the pumps, it was found that in many instances pumping units were specified for the maximum possible head. With centrifugal pumps of low specific speed, a change in head would have only a small effect on the discharge. The efficiency curve is flat and the loss of efficiency, due to operation at substantially lower head, does not impose an excessive penalty.

High-Speed Pumps

With high-speed pumps of the axial-flow or propeller type, the efficiency curve is much steeper than with centrifugal pumps, and range of high efficiency much narrower. The head curve tends to be flatter, and, since the total head is low, a small change in head usually amounts to a substantial proportion of the total pumping head and causes impairment in discharge. It may also cause the pump to operate far beyond maximum efficiency. Loss of efficiency alone is important, but it is also most desirable to avoid running such pumps beyond their best efficiency, since the tendency toward local cavitation, vibration and other difficulties becomes more pronounced.

By giving the manufacturer complete information on the expected operating requirements, the range in discharge

and range in head for normal conditions, and by requiring sufficient experimental work to prove out the proposed design, it is hoped to have as complete freedom from operating difficulties from this source as possible.

Shutoff-Valves

Between the pumping unit and the conduit it is necessary to have some form of shutoff valve. After a study of the operating requirements, hydraulically operated butterfly or pivot valves were selected, which can be opened or closed sufficiently fast to permit them to operate as check valves. This avoids the necessity of draining and refilling the discharge line each time power is cut off from the pumps, or during emergencies. These valves will be arranged with a separate oil-pressure system and accumulator tank which will have a sufficient supply of power fluid to close the valves in case of a power failure, hold them closed, and reopen them upon restarting the pumps.

Controls for these valves will be interconnected with controls for the pumps, which are driven by induction motors having liberal torque allowances for starting. It is not expected that it will be necessary to open the check valves in advance of starting the pumps.

On shutting down a pump the check valve will be closed automatically, making the first part of its travel at a rapid rate and the last part at a much lower rate. This will provide against excessive backward flow through the pump and will retain most of the water in the conduit. The check valve itself will act to relieve any surge due to water hammer, and timing adjustment can be made to permit the valve to go through each part of the closing stroke at any desired rate.

Testing Program

A feature of this project is a comprehensive model-testing program conducted to solve certain pump, circulating-water-discharge, condenser and other hydraulic problems, the results of which were given in the paper.

Other papers on pumps presented at the hydraulic sessions included one on "Selection and Operation of Centrifugal Pumps for Pipe Lines," by Aladar Hollander and another, "Tests for Centrifugal and Propeller Pumps" by G F Wislicenus.

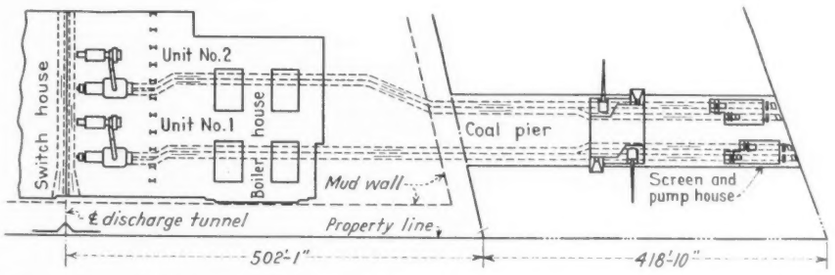


Fig. 5—Circulating-water pumps are on the coal pier 650 ft away from the condensers

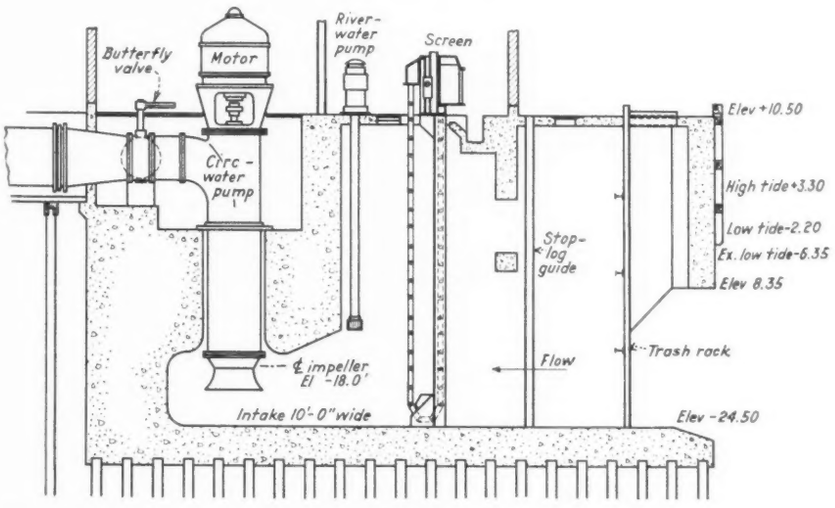


Fig. 6—Elevation through the intake for the Southwark circulating-water pumps

Bonneville Spillway Gates

Feature of the Bonneville project which have attracted widespread attention were described in a paper by T M Ober. This project is located in tidewater on the Columbia River approximately 140 miles from its mouth and 42 miles east of Portland, Ore.

As finally designed, the ten turbines have a rating of 66,000 hp under 50-ft head. These are the largest Kaplan units ever built and the generators they drive are the largest in physical dimensions so far constructed. Noteworthy among the interesting features of the plant are the eighteen 225-ton vertical-lift spillway gates, operated by two 350-ton gantry cranes and the variety and number of fishways requiring numerous gates and lifts. The great size of steel units involved in the construction required unusual care in erection. Six of the gates are 50 ft wide by 60 ft high and 12 are 50 ft wide by 50 ft 9 in. high, each gate being made in two sections.

Close Tolerances

They may be raised clear of the water during high flow. One complete 50-ft gate weighs approximately 450,000 lb and the total hydraulic pressure against it is about 4,190,000 lb. One complete 60-ft gate weighs 560,000 lb, and the total hydraulic pressure against it is 5,800,000 lb.

From his experience in the erection of large structural steel members in this project Mr. Ober drew the conclusion that where close tolerances on embedded structural steel are required it is best to employ the so-called grouting system. This method requires setting the steel after the main body of the concrete has been poured. Recesses are made by using box forms with reinforcing bars or ties for the structural steel left exposed. After all forms have been stripped the structural steel can then be placed, lined up by means of piano wires and other devices, and the cement grout placed around it.

Selection of Vane Angle

Analytical treatment of energy transfer between a working fluid and a rotor for pumps and turbine machinery, which affords means for selection of the vane angles and general arrangement best for a machine for a given service, and for determination of detailed dimensions of a machine, for a particular pressure condition, were presented in a paper by Sanford A Moss, Chester W Smith, and William R Foote. A single general formula was given which applies to every type of machine. In this study, a kinematic treatment of rotor energy is first given, which is followed by an hydraulic and thermodynamic treatment of fluid energy. The relations set forth are then applied to pumps and turbines of the axial-flow and of the radial-inward-and outward-flow types.

Science Tackles Embrittlement

▶ THE WAY HAS BEEN OPENED, concluded E P Partridge of Hall Laboratories, for approach to the problem of cracking by testing as an engineer and not by arguing as a lawyer. Results in over 100 plants obtained with field detectors and laboratory tests numbering 1300 or more were presented at a symposium on the general subject of embrittlement.

Two general types of embrittlement detectors have been in use. Fig. 1 illustrates the laboratory type developed by Dr Straub of the University of Illinois. Fig. 2 is the Schroeder unit intended for field application directly to the blowdown line of the boiler suspected of cracking tendencies.

In testing a boiler-water sample with the laboratory unit, 7 cc are placed in a bored-steel specimen containing a plunger machined to a diameter a few thousandths less than the specimen. The unit is contained in a heating furnace and stressed to 40,000 psi. If the water is embrittling, the specimen will usually break within 24 hr. If no failure occurs within 30 days, the water is classed as non-embrittling.

Tests Check Operation

A new specimen is used for each water sample. Additional tests can therefore be made after various chemicals have been added to see what types of treatment would prevent failure.

In reporting results, Dr Straub stated that, at 400 F and low NaCl content, sulphates do not appear to be effective in preventing failure of the test specimen. With relatively high NaCl content, however, he added, the combination of sulphate and chloride appears to be effective. At higher temperatures, certain combinations of chlorides and other constituents prevent failure. Definite correlation between laboratory tests and actual operation has been obtained, he said, since tests indicate that sulphate is effective in preventing failure in the laboratory at pressures that have resulted in the greatest percentage of embrittlement failures in steam boilers.

Experiences with the Schroeder detector were presented by T E Purcell and S F Whirl of the Duquesne Light Co. A program begun in 1938 included 26 tests in three stations. Some indicated a tendency toward embrittlement and others did not result in specimen failure. Content of sodium nitrate in the boiler water, the authors stated, may be responsible for non-cracking of the specimens. It was found, in a number of tests, that specimens showing no cracks at the end of 30 days showed marked etching after 60 days and complete failure at 90 days.

While boilers have been known to operate for many years with leaky seams, the detector specimens fail within a relatively short time. This condition should not result in criticism of the detector, according to the authors, because accelerated failure of the specimen offers increased assurance against failure of the drum metal itself.

Synthetic Inhibitors

Additional series of tests on synthetic solutions as well as boiler waters were tabulated by P G Bird and E G Johnson of the National Aluminate Corp. These results indicate that sodium nitrate is one of the best inorganic substances for inhibiting embrittlement but only when combined with other organic matter. There is no indication, report the authors, that inorganic salts ordinarily found in boiler waters exert pronounced protective action. This is also true, they add, of sodium sulphate when following the ASME ratio.

With a given feedwater, it was found that increasingly large amounts of inhibitors were required as the number of concentrations increased. Highly effective inhibiting action, however, has been demonstrated for a number of chemicals by tests on synthetic solutions. The authors add a word of caution on the use of the Schroeder embrittlement detector, stating that it is a highly valuable instrument only if great care is taken in making necessary adjustments so that tension is always maintained on the under side of the specimen and resulting deposits are not blown or washed away.

Their procedure applies tension to a polished specimen before boiler water is admitted by tightening the adjusting screw. When ready for operation, the clamp is loosened just enough to produce a small leak. The water leak is then adjusted daily by a fraction of a turn on the adjusting screw. Alternate adjustment of clamp and screw must keep the specimen under stress and the leak small to avoid washing away accumulated deposits.

A comprehensive paper by E P Partridge, C E Kaufman and R E Hall, all of Hall Laboratories, compiles results of experience with the Schroeder detector in over a hundred plants. The authors commend both the Straub detector and the Schroeder field unit as real achievements in the study of cracking.

The laboratory detector, they state, assures a uniform procedure by specially trained personnel but the samples tested may not represent the actual boiler water. The field detector automatically integrates fluctuations in composition of boiler water during any test period but unavoidably introduces variation in the personal factor.

Intergranular cracking, the paper continues, is evidence of the cooperation of several essential chemical and mechanical factors. Boiler water must have concentrated greatly, a hundred or thousand fold. The concentrated solution must have been in contact with steel under high applied or residual stress. The chemical composition of the concentrated solution must have been such as to lead to localized corrosion at grain boundaries rather than general attack.

What Detector Shows

The absence of cracking in a riveted seam may be due to the absence of any one of these factors, either too much or too little leakage so that concentration does not occur, or deposit formation at a point of low stress. The detector, on the other hand, assures the presence of all factors except the embrittling nature of the water.

If the specimen fails to crack, the operator will feel reassured as to the future of the drum metal. Cracking of the specimen does not necessarily mean that embrittlement is in actual progress in the drum, but only that the boiler water under test is capable of promoting cracking if mechanical conditions in the drum combine concentration with stress.

Problem

Where cracking of the specimen is experienced, the detector can then be used to evaluate the success of inhibitive treatment. Of the various substances suggested as inhibitors, the authors presented results of tests on sodium sulphate, chloride, phosphate and nitrate, alumina, and organic products such as tannin and lignin.

Briefly summarizing a practical program to avoid cracking, the authors suggest neither sulphate nor chlorides above 250-lb pressure, nor do they consider alumina effective as an inhibitor. Phosphate also appears, conclude the authors, to be without effect as an inhibitor and the experience with nitrate does not yet justify any definite conclusion. Tannin, however, seems effective in the range up to 650 lb in which it has been used to date.

Comparing railroad to stationary practice, R C Bardwell and H M Laudemann of the Chesapeake & Ohio R R indicated that good practical results have been effected in reducing boiler failures due to embrittlement by the use of waste sulphite liquor and, subsequently, sodium nitrate.

In discussion, W C Schroeder and A A Berk of the Bureau of Mines summarized the practical results of the investigators. The papers showed, Dr Schroeder emphasized, how to determine if a boiler water is embrittling and methods that can be followed to make it non-embrittling.

The statistical analysis of all the embrittlement tests definitely shows a decrease in cracking of the specimens as the ratio of tannin to sodium hydroxide in the boiler water is increased. Very low ratios prevent cracking up to 250 lb, but above this value proportions must be increased to about 0.4 to secure complete protection.

Tannin and Lignins

If detector tests show that the water will cause cracking, added tannin is reported effective at pressures from 140 to 650 lb. Other investigators show that a small amount of sodium nitrate makes tannin more effective. However, if the nitrate concentration becomes too high, it may oxidize and destroy the tannin so that no protective agent remains in the solution.

Lignin sulphonate compounds show definite protective action in most cases. Waste sulphite liquor, containing lignin sulphonate, was effective in locomotive operation also.

At pressures above 250 lb data from the entire symposium show that sodium sulphate will not stop cracking. In the face of evidence from five different investigations varying from refined laboratory technique to field tests of operating locomotive boilers, present recommendations for use of sulphate to prevent embrittlement lose significance. There is no consistent evidence from the combined data that sodium sulphate will stop cracking of the specimens at any boiler pressure. Above 250 lb, all data from this symposium are in agreement that sulphates have no protective action.

While results show no embrittlement protection from phosphate in the presence of sodium hydroxide, boiler operators have eliminated tendency to crack by the most direct method of all. Elimination of hydroxide by addition of phosphate alone can be used as treatment of boiler water when the latter is composed of condensate and evaporated makeup. An ingenious method of measuring the absence of hydroxide by calculated phosphate-pH ratio is a definite contribution to existing practice.

Data have been presented showing that sodium nitrate will prevent cracking at pressures below 450 lb. However, low nitrate concentrations did not prevent cracking when the pressure exceeded 600 lb.

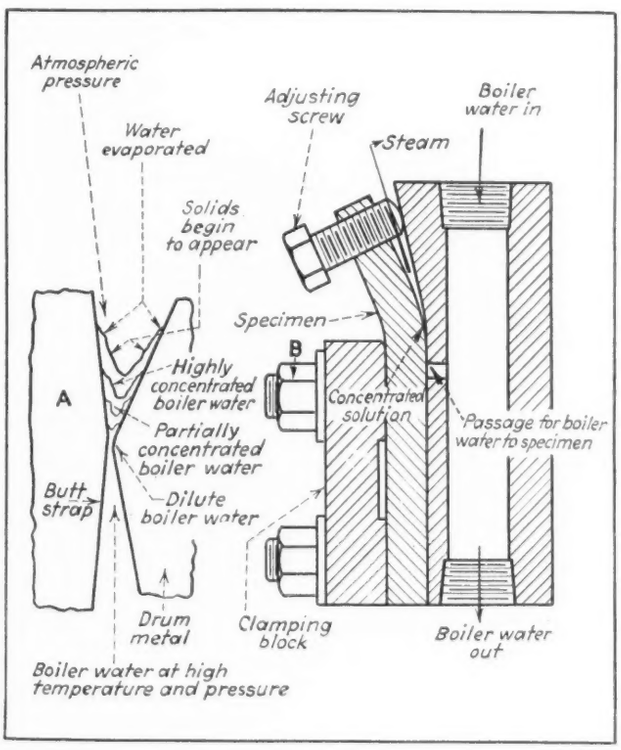


Fig. 1—Laboratory-type detector developed by Straub and his associates at the University of Illinois

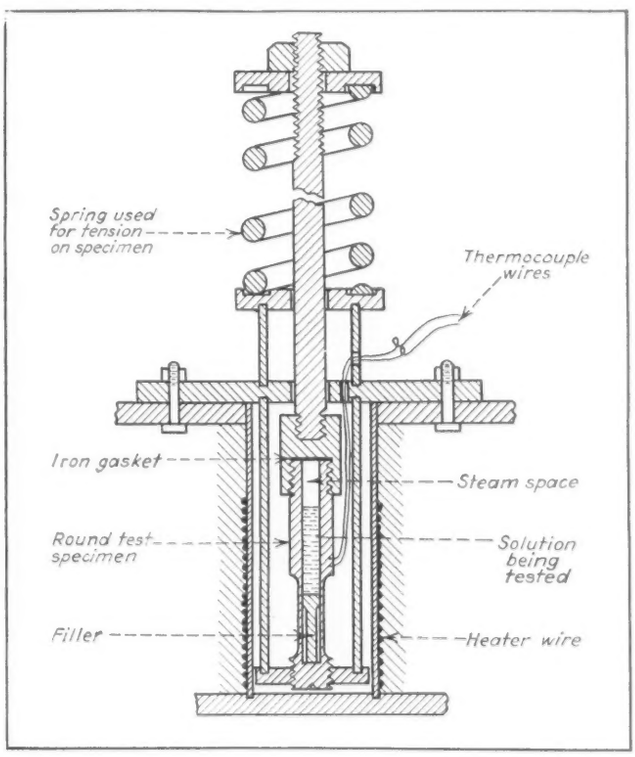


Fig. 2—Field unit for cracking tests designed by Schroeder, Bureau of Mines, for boiler blowdown line

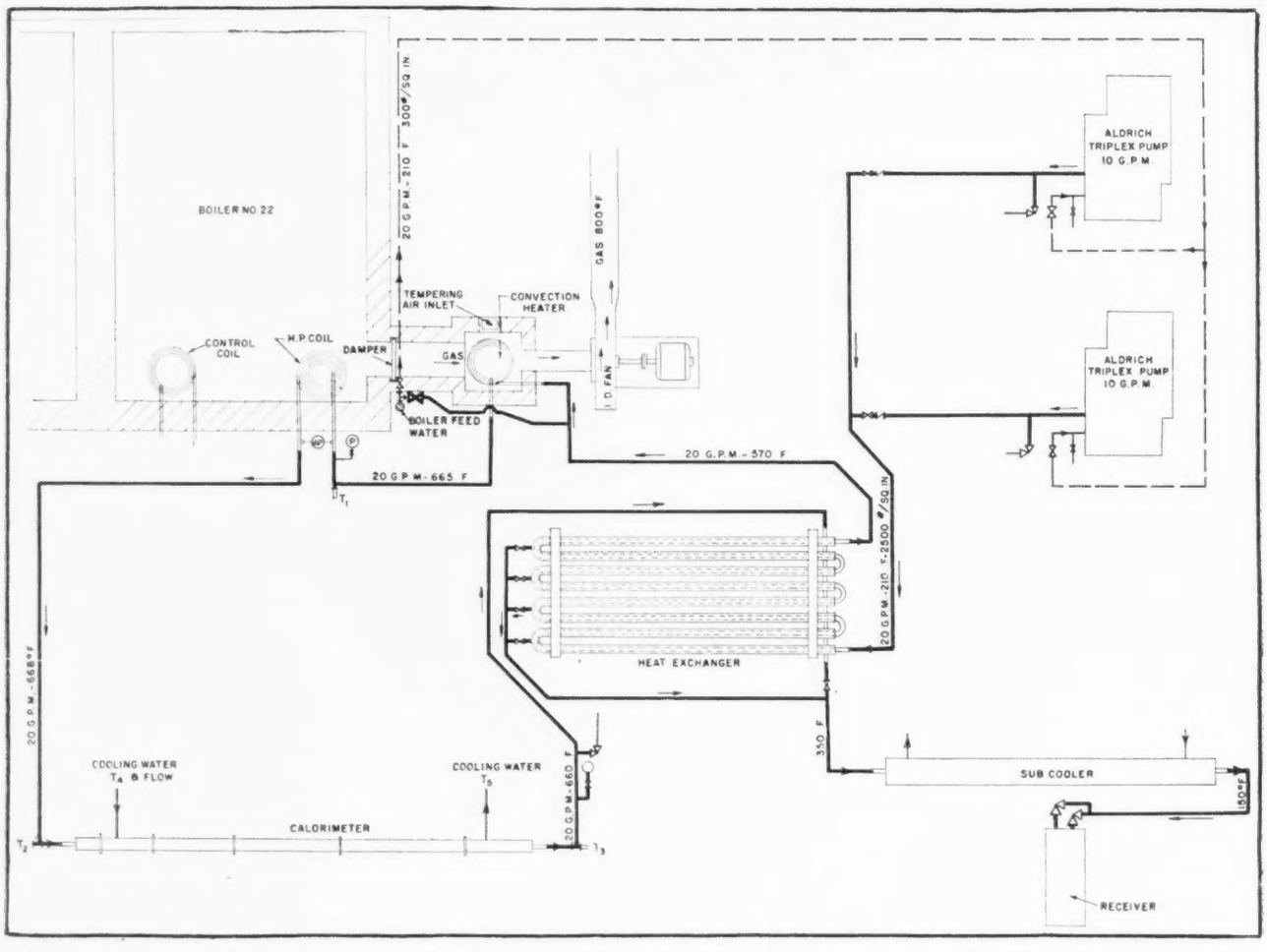
Research Yields Furnace Data

▶ Research Engineers, working with new and unusual methods, promise to provide much valuable basic data for those interested in furnace design and pulverized-coal combustion, according to reports presented at this meeting. Much of this work is in its initial stages and further experiment and analysis will be needed before the results can have practical value, but the material available to date indicates the potential value of these investigations.

Extension of data on heat transfer and pressure drop in steam-generating tubes from laboratory scale to units producing better than 500,000 lb per hr, and from existing low-pressure designs to those at pressures approaching the critical involves many uncertainties. Likewise, data on performance of existing steam generators deals, with few exceptions, with average values for large elements, such as the entire waterwall, rather than with individual tubes. For these reasons, the Consolidated Edison Co of N. Y. carried out an extensive study of heat transfer and pressure drop in tubes at pressures from 500 to 3300 lb per sq in. under exposure to furnace heat in large steam generating units.

Describing the methods and apparatus, the authors (Messrs W F Davidson, A R Mumford, P H Hardie, A A Markson, C G R Humphries, and T Ravese) stated that most of the test surfaces were flat spirally coiled tubes installed on the rear wall of an oil-fired boiler. The diagram shows the apparatus required to preheat water to the saturation temperature for any test pressure and later to cool it before dissipating the pressure. Instruments were provided to measure quantity of fluid flowing, fluid pressures, pressure drops, and fluid and metal temperatures. For comparison, a straight tube, 50 ft long, was tested in another furnace of sufficient height.

The report gives the results of tests made (1) to determine influence on tube-metal temperature of steam-water ratio and of liquid under conditions of rising temperature in absence of evaporation, (2) to determine flow resistance of steam-water mixtures and of liquid under conditions of rising temperature in absence of evaporation, and (3) to determine influence of variations in tube dimensions. Data is also presented on the pressure drop through flow-distributing equipment designed for forced-circulation boilers and on the determination of heat-transfer coefficients for the specific types of heat-exchanging equipment used in the



Equipment used to preheat water to saturation temperature for various test pressures and to cool it before dissipating the pressure

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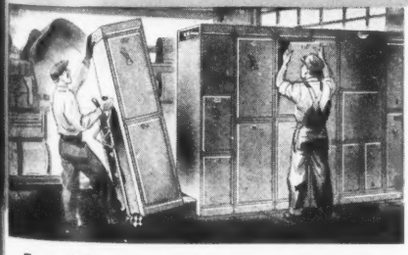

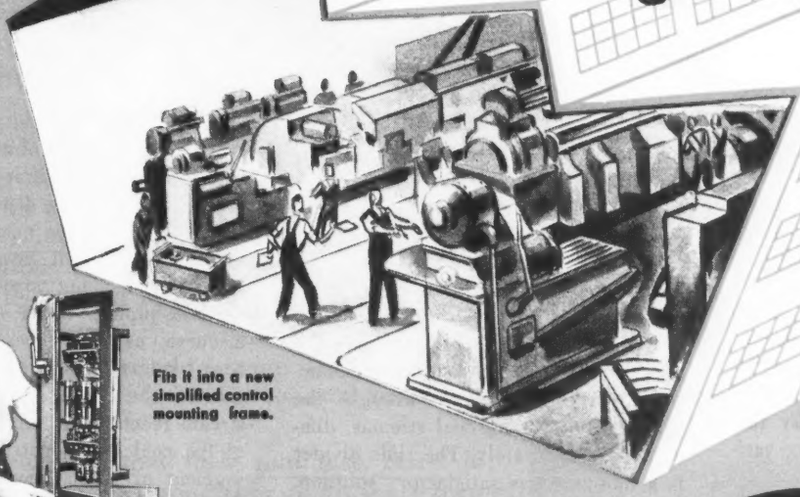

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tests. In most cases, data covers a pressure range of 500 to 3300 lb per sq in., and a heat-transfer-rate range of 30,000 to 200,000 Btu per hr per sq ft.

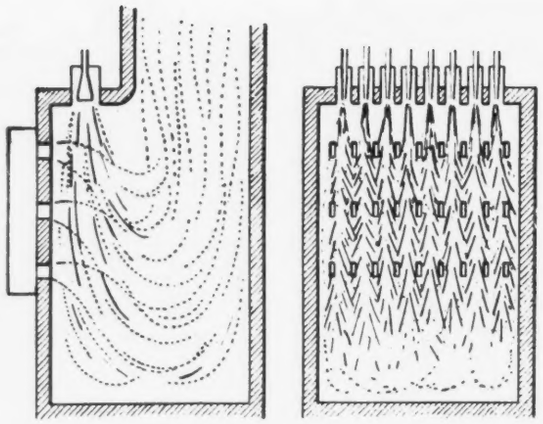
In problems involving the exchange of heat energy by radiation between bodies, it is necessary to know what areas of the bodies "see each other". Factors expressing mutual visibilities are known as *configuration factors* and have usually been determined by mathematical analysis or by actual experiment with bodies radiating heat energy. A paper by Fred England, Mass. Inst of Technology and H O Croft, University of Iowa, described an experimental method of determining configuration factors by using models of furnace cavities and exchanging light instead of heat energy, possible because both follow essentially the same laws.

The apparatus consists of a constant light source, a specially mounted photoelectric cell, a standard photoelectric cell, a potentiometer, a dark room, a Weston illumination meter, and a standard magnesium-carbonate reflector. Four model furnaces were used; configuration factors were found for various wall conditions and intensity factors were found for walls having various absorption coefficients.

Study Burning Particles

Conditions in pulverized-coal furnaces have been determined but such information tells very little about what happens to the individual coal particle. Using a laboratory furnace in which coal particles drop between heated plates at controlled temperature, A A Orning, Carnegie Institute of Technology, was able to record the temperature history of individual burning particles, photographically. With low-ash fractions of Pittsburgh, Pocahontas No. 3 and Illinois No. 6 coals in sizes ranging from 40 to 200 mesh, tests showed non-uniform ignition at temperatures below 850 C and increasing degree of combustion with increasing temperature through 950 C. Probably the most important result of the investigation, to date, is demonstration of the fact that changes which occur before the particle of coal ignites exert considerable influence on the subsequent combustion.

In a contrasting paper, dealing with practical problems of pulverized-coal burning, Henry Kreisinger and V Z Caracristi, Combustion Engineering Co, stated that the principal function of a pulverized-coal burner is to distribute air evenly in a furnace. Failure to do so means that parts of the furnace receiving too much fuel are subject to high temperatures and heavy slagging while parts receiving too little air suffer incomplete combustion even though high overall excess air is maintained at the furnace outlet.



Even spacing of vertical burners set in arch and of secondary-air ports in wall produces relatively even distribution in vertically fired furnaces.

The relative ease of achieving even distribution with vertical firing and the fact that the bin system with individual feeders for each burner was particularly adapted to this scheme probably explains the use of vertical firing in the early days of pulverized coal. Introduction of the unit system brought the problem of dividing coal streams, difficult to do accurately. The riffle divider is a more or less satisfactory solution.

Horizontal firing, with a small number of burners, came into use with the unit system, simplifying furnace design and reducing cost by eliminating the arch used with vertical firing. Horizontal burners are characterized by turbulent flow, making it possible to distribute coal from each burner over a larger part of the furnace. Therefore, horizontal firing makes it possible to reduce the number of burners per furnace, and simplifies the piping.

The horizontal burner is sensitive not only to adjustment of its own parts but also to the design of the fuel piping. Even distribution of coal and air to the furnace is more difficult than with the vertical burner. In the first place, there are fewer burners, and the fuel streams entering the furnace are larger. The path of the burning mixture between the burner mouth and the boiler is usually shorter than with vertical firing. Consequently the coal and air distribution across the entire cross-section of the moving stream of burning mixture must be accomplished in a short distance from the burner.

The more bushy the flame, the shorter will be the distance required for the uniform spreading. Bushing of the flame is proportional to the rotative movement of the secondary air and the smaller the pitch of rotation the greater will be the bushing out of the flame. The small pitch requires higher pressure both primary and secondary air.

To make bushing of the flame effective, it is necessary that the pulverized coal should be evenly distributed around the periphery of the nozzle tip. This is difficult because it involves not only burner design but also the shape of the fuel piping. When a fuel pipe has a curve, as fuel pipes usually have, coal tends to concentrate on the outside of the curve. Usually when the stream reaches the burner a large part of the coal is concentrated in a small segment of this section. If nothing is done to break up this concentration, the coal leaving the burner nozzle will be thrown to one side of the furnace. This defect is probably the most common found in servicing new installations and may occur in spite of all care given to burner design. Burner designers are now concentrating on arrangements to take care of concentrations caused by unavoidable piping bends.

Approach arrangements also affect the equally necessary even distribution of air. The air comes to the burner through a duct either at one or both sides of the burner, top or bottom, or both. The approach may be such that the path of air flow is more direct to some of the adjustable vanes which give it rotation. As a result of this uneven approach of air to the vanes, one side of the furnace may get more air than the other.

With tangential firing, streams of fuel and air are directed from the four corners of the furnace tangent to a small circle in the center of the furnace. Enough primary air is supplied to start ignition but no attempt is made to mix secondary air with fuel at the burners. The ignited mixture is blown toward the center of the furnace and the course of the streams from the four corners produce rotative movement, which is much greater than the rising movement. The intermingling of the streams equalizes the distribution.

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Wanted—Bearing-Lubrication Data

▶ EXPERIMENTAL DATA ARE NEEDED on the over-all heat-transfer constants governing the relation of power loss to temperature elevation in oil-film bearings, according to the paper presented by Mayo D Hersey, consultant, National Research Council. The effect of oil flow on load capacity should be further investigated, he said, as well as better methods for measuring or calculating film temperatures.

The fact that true film viscosity is usually an unknown quantity constitutes one of the reasons for research on temperature relations in bearings. Under steady running conditions the mean temperature of the oil film gradually reaches some maximum limiting value known as the equilibrium temperature.

Temperature Difference

This remains constant as long as the ambient temperature remains unchanged. The difference between film temperature and ambient temperature may vary from a few degrees up to 100 F or more, depending on numerous factors. Investigation along these lines depends on the availability of heat-transfer data.

Water-cooling by coils in the oil bath is more effective than air cooling. The rate of heat transfer depends on such factors as the shaft speed, shape and size of cooling coil and housing, rate of flow, water inlet temperature, bath temperature, oil viscosity at bath temperature and temperature coefficient of viscosity. With forced lubrication and external cooling of the oil the rate of heat transfer depends on the temperature elevation of the film above the inlet oil rather than above the room temperature.

Load capacity may be expressed in terms of film thickness, film stability, or temperature rise. These conceptions would seem to reflect the viewpoints of the designer, experimenter, and operator, respectively, though there is much ground in common. The operating engineer cannot see the oil film, but by touching the bearing and checking the temperature of the outlet oil he can form some judgment as to the permissible operating temperature. The temperature in the oil film cannot be strictly uniform after reaching equilibrium, since the heat originating in the film can be removed only by convection and temperature gradients.

When the load on a bearing is increased, and the speed or viscosity sufficiently decreased, the condition of operation changes from one of thick-film lubrication to a thin-film lubrication, in which the high spots on the two rubbing surfaces are beginning to experience boundary lubrication. Thin-film lubrication embraces a variety of phenomena, for example, the heat generated locally by the rapid tangential motion of high spots on the opposite sides of the film must have some effect on the total frictional resistance.

Some bearing surfaces are expected to run warm because of heat from other sources, others overheat from excessive friction. Excessive friction is caused by misalignment, eccentric loading, oil-supply failure, improper finish or adjustment, and unsuitable bearing metal. With the increasing loads and speeds to be dealt with in bearing practice, a systematic study of heat conditions will be required.

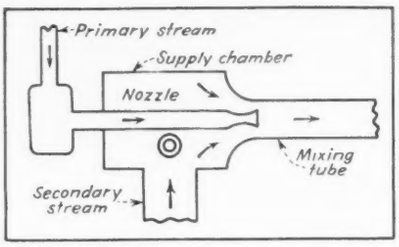
Characteristics of centrally supported journal bearings were discussed in a paper by E O Waters, assoc professor, M E, Yale University. His investigations covered the properties of bearings having specified entering and leaving angles, to compute the capacity and load-line direction of each, and then, by interpolation, to find the properties of those bearings whose arcs of contact are 80, 100, and 120 deg, and whose load lines come midway between the angle of entrance and the angle of exit. Calculations were completed on 108 different bearings. The primary purpose of this study was to determine the load capacity and friction of journal bearings having different arcs of contact, eccentricity ratios ranging from zero to unity, length-width ratios from zero to infinity, and central support.

Ejector Performance Studied

"A Simple Air Ejector" was the subject of a paper presented by Assoc Professor J H Keenan and E P Neumann of Mass. Inst of Technology. They presented the results of studies of the performance of the simplest form of ejector which would function in a useful manner. The object was to analyze its performance as nearly independently of data on ejectors as possible, and to compare the actual performance with that predicted analytically.

The ejector chosen for these studies consisted of a cylindrical tube with a rounded converging entrance as shown by the sketch. A nozzle fed with fluid at high pressure, discharges into the entrance to this tube. The stream entrains fluid in the tube and causes a secondary flow from a supply chamber surrounding the nozzle. The primary and secondary streams mix and issue from the tube into the atmosphere. This mixing of the two streams occurs at constant total cross-sectional area.

An ejector of this type can pump secondary fluid into an exhaust space at a pressure higher than the pressure in the secondary chamber. If mixing occurs at constant pressure instead of at constant area the pressure at the exit of the mixing tube cannot exceed the pressure in the secondary supply chamber. This means that in the absence of a diffuser a constant-pressure ejector can serve only as a blower and not as a pump.



Experiments with this ejector show that the best position of the exit of the primary nozzle is only a short distance up stream from the throat of the secondary nozzle. The best length of the mixing tube is slightly greater than 7 diameters.

The object of these experiments was to test the utility and the validity of a method of analysis.

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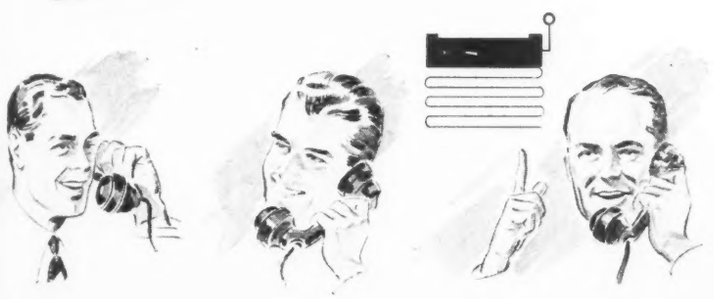

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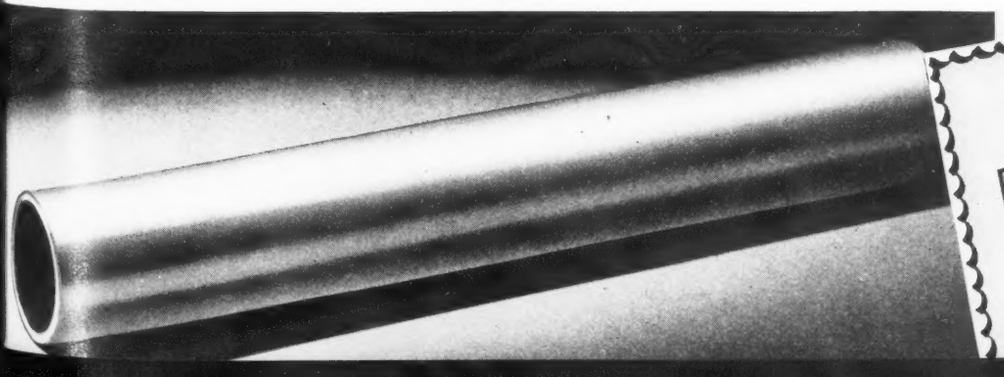

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more, if desired by operator. Primary current is 1.57 amps, no load, 52 amps full load. *Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.*

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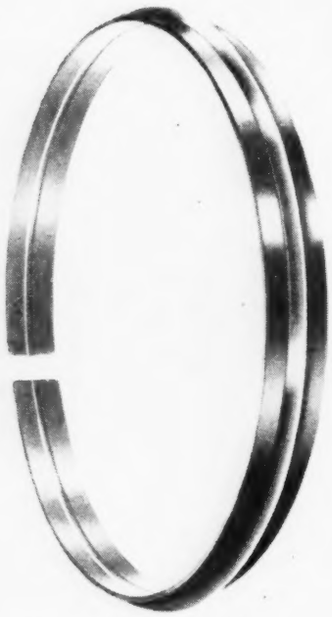
WELDING TIMER—Ignitron timer adapted for seam and spot welding where frequent changes of timing are necessary. When weld initiating switch is closed, relay closes its contacts. At a predetermined point in voltage cycle, corresponding to power factor of welding machine, the start tube in the "on" timing circuit is energized, and the ignitrons begin to conduct. At the end of the "on" time interval, the stop tube in that circuit becomes energized, and simultaneously the start tube in the "off" timing circuit is energized. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

(Continued on page 108)



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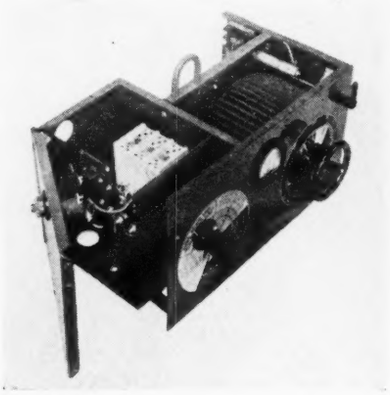

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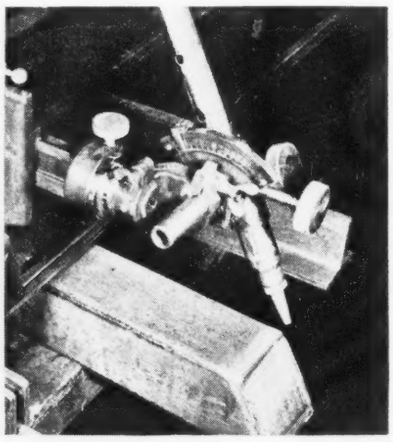

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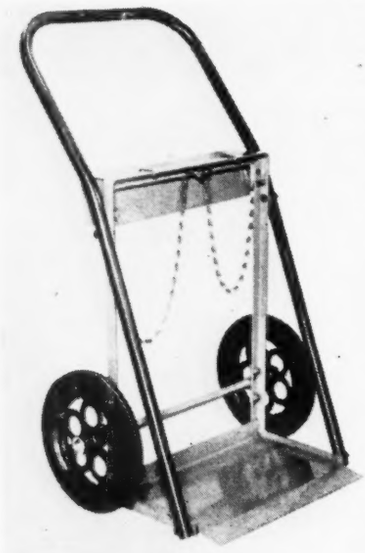

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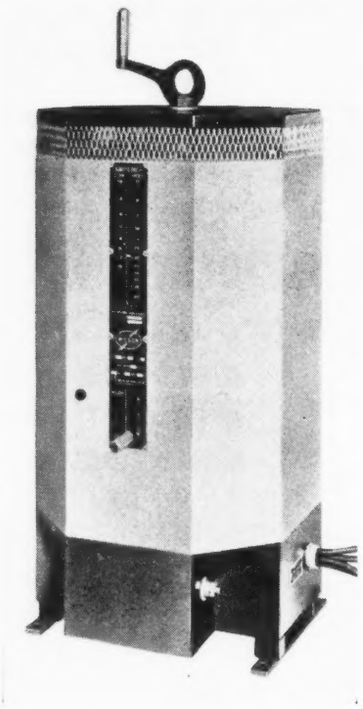
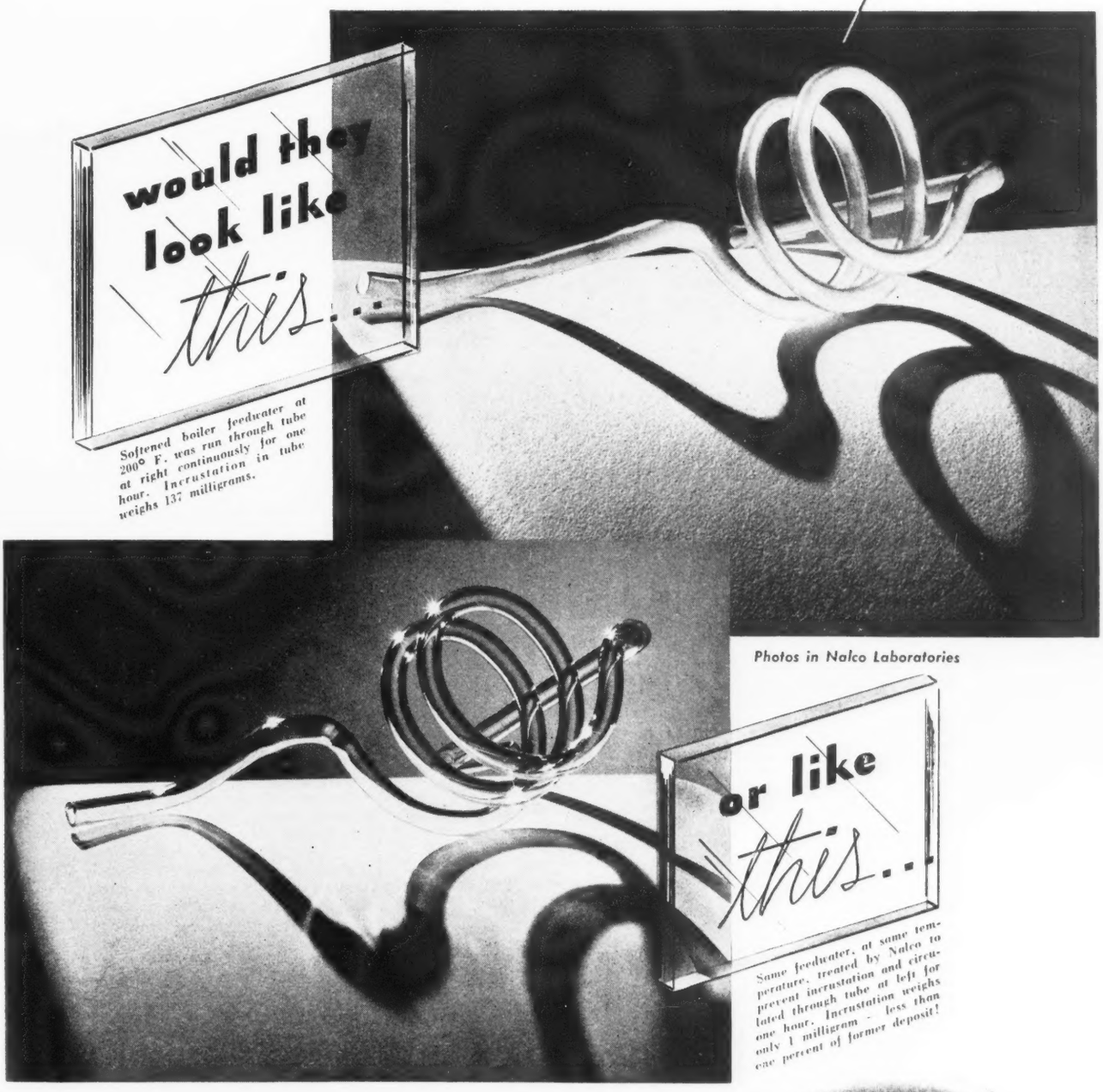


IF YOUR FEEDWATER LINES WERE *Glass..*


would they look like this...
Softened boiler feedwater at 200° F. was run through tube at right continuously for one hour. Incrustation in tube weighs 137 milligrams.
or like this...
Same feedwater, at same temperature, treated by Nalco to prevent incrustation and circulated through tube at left for one hour. Incrustation weighs only 1 milligram — less than one percent of former deposit!

Photos in Nalco Laboratories

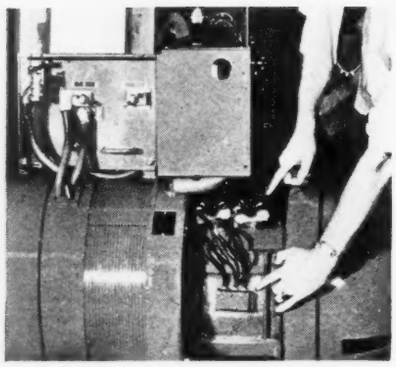
NALCO stabilized water that keeps feedwater lines clean is a small but important part of the integrated Nalco System. Research and experimentation in the Nalco Laboratories saves time and money in the field — Insures maximum economy and efficiency wherever the Nalco System is in use. Nalco Engineers will be glad to make recommendations for a complete solution of your water treatment problems. Write or call today.

Nalco - the Complete Water Treating Service

NATIONAL ALUMINATE CORPORATION

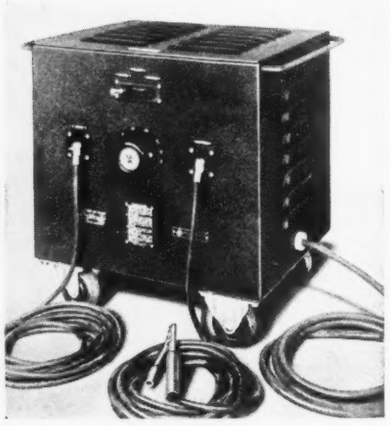
6222 West 66th Place • Chicago, Illinois

Canadian inquiries should be addressed to ALUMINATE CHEMICALS LTD., 555 Eastern Avenue, Toronto, Ontario



WELDING CONTROL—Complete protection against heat or excessive current provided by device. Consists of two current transformers (see illustration above), primaries of which are connected into series with motor leads and the secondary supplying power to operate two snap-action thermostats. These thermostats are connected to the lamination in such a way that they operate by means of heat conduction as well as by current passing through thermostat. *Lincoln Electric Co, Coit Rd, Cleveland, Ohio.*

ARC WELDER—Ac welder is similar to BB series of company welders. Class B, all-asbestos insulation, silicon steel, and aluminum angle framework used in construction. (Illustration at right). *Marquette Mfg Co, Minneapolis, Minn.*



ARC WELDER—Weld-O-Tron low-current electronic designed for range of from 5 to 40 amps. Consists essentially of 3-tube polyphase mercury-vapor rectifier circuit, eliminating all rotating parts. Handwheel with easily read dial provides fine adjustment. (Photo in center, above). *Allis-Chalmers Mfg Co, Milwaukee, Wis.*

WELDING MACHINES—Portable welding machines with built-in transformer, entire unit designed for suspension from monorails, making unit, in effect, a cross between a pedestal and a gun welder. *Progressive Welder Co, Detroit, Mich.*

WRENCHES AND OTHER TOOLS

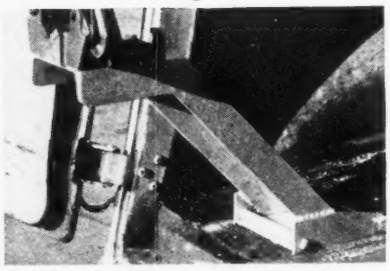
1 HYDRAULIC VISE—Studebaker hydraulic vise designed to speed up small press and cutting operations can also be used for normal vise work in power plant maintenance and repair shops. Pressure to control closed jaws is controlled by foot-pedal-pump arrangement in pedestal mounted on floor. Illustration shows vise arrangement as attached to ordinary work bench. *Studebaker Machine Co, Chicago, Ill.*

1

2 IMPACT WRENCH—Air-operated impact wrench designed with Pott wrench principle which localizes steel-to-steel impact without transmitting shock to other tool parts. *Ingersoll-Rand Co, Phillipsburg, N. J.*

2

3 VISE BRACKET—All steel bracket can be attached to floor of truck as shown, and can be used for mounting either a pipe or machinist's vise. *Jiffyon Mfg Co, 1752 S Taylor Rd, Cleveland, Ohio.*

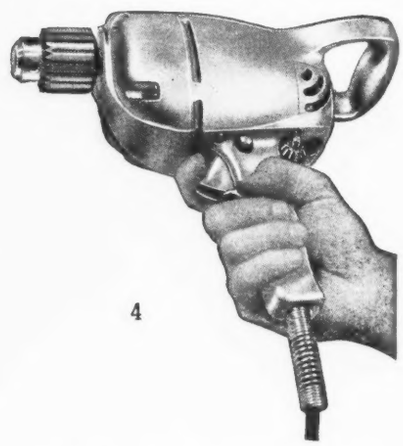


3

4 ELECTRIC DRILL—"Blue Point" drill built to meet need for lighter and more compact unit for constant production or repair service. No-load speed is 450 rpm, while full load speed is 300 rpm. *Snap-on Tools Corp, Kenosha, Wis.*

VISE STAND—"Vistand" is balanced and designed for either portable or stationary use. Features of platform include tool notches and slots around the rim, oil-can recess and a special "dope pot." *Armstrong Mfg Co, Bridgeport, Conn.*

SOCKET SET—Addition to Bonney line is TD12 socket set, containing 20 pieces for making practically any combination desired. Made of chrome-vanadium steel and provided with rust-resistant finish. Includes sockets with 5/16 in. to 3/4 in opening, extensions, ratchets, handles, joints attachments and accessories. *Bonney Forge and Tool Works, Allentown, Pa.*



4

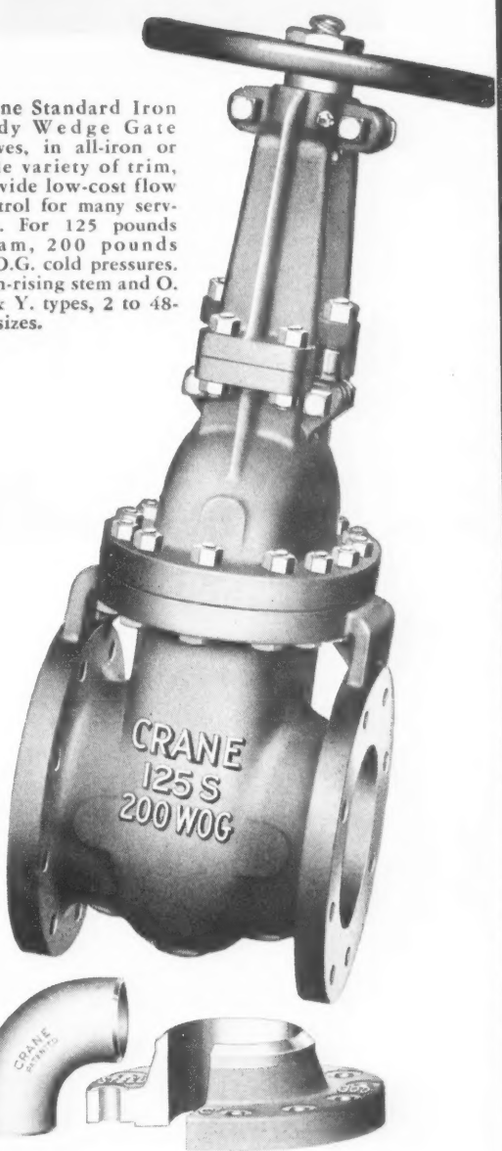
. . . THE Wrong Time FOR POWER PIPING TROUBLE

TROUBLE at any time is bad. But if America is to have more guns and tanks, more planes and battleships, there will be no worse time for power breakdowns than with the turn of the calendar.

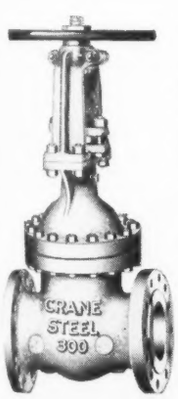
In every industry, today, power men are protecting against valuable time and production losses. They're making sure that valves are right—safe and dependable—for next year's stepped-up power demands.

If you're at all unsure about any valves, your Crane Man stands ready to help forestall trouble. You can depend on him for accurate application data on valves and fittings; he's backed by the complete Crane line of time-tested piping equipment for every power plant need.

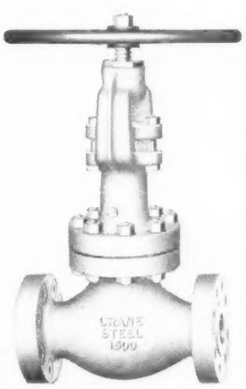
P. S. For modern pipe fabricating service—on small jobs or large—see your Crane Representative.



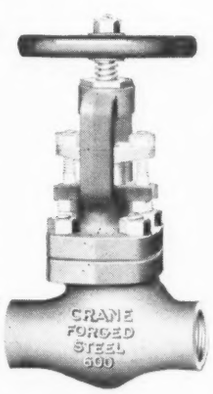
Crane Standard Iron Body Wedge Gate Valves, in all-iron or wide variety of trim, provide low-cost flow control for many services. For 125 pounds steam, 200 pounds W.O.G. cold pressures. Non-rising stem and O. S. & Y. types, 2 to 48-in. sizes.



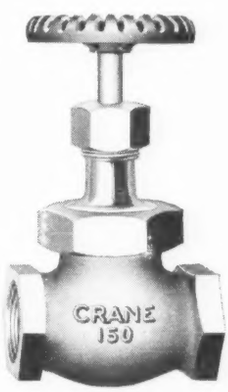
(*Left*) 300-pound Crane Alloy Cast Steel Wedge Gate Valves have long close-fitting guides which accurately seat disc and minimize disc wear. T-head disc-stem connection prevents lateral strains on stem. Sizes: 1¼ to 24-in.; screwed, flanged, or butt-welding ends.



(*Left*) Crane Alloy Cast Steel Globe and Angle Valves for steam and water at pressures up to 1500 pounds. Plug-type disc design resists severest throttling conditions—gives positive flow regulation—assures lasting tight seating. Sizes: 2 to 6 in.; flanged or butt-welding ends.



(*Right*) Rated at 600 pounds, 750°, Crane Small Steel Valves are ideal for severe pressure-temperature conditions. Efficient, safe, and easy to service. Gates, globes, angles, and checks; in 8 sizes up to 2-in.; screwed, flanged, or socket-weld ends.



(*Right*) For pressures up to 350 pounds, Crane Brass Plug-Type Disc Globe and Angle Valves can't be beat in throttling jobs. Wide seating surfaces minimize damage by foreign matter, resist wiredrawing, and make positive closure. In 1 to 4-in. sizes.

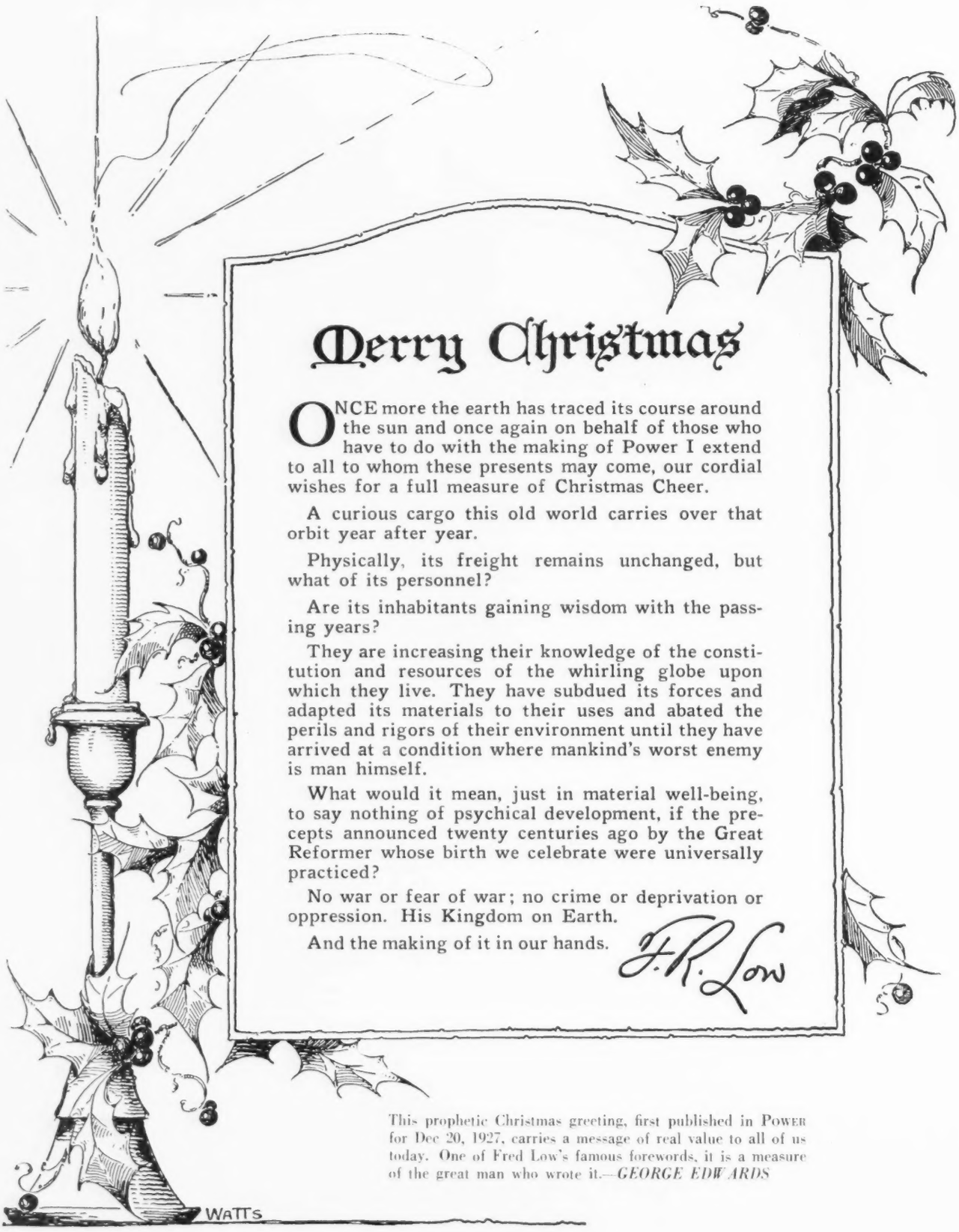
Crane Welding Fittings and Flanges are made of steel having greatest resistance to temperature, shock and strain, and with high weldability. Machine beveled. In all sizes and pressure classes.

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS



Merry Christmas

ONCE more the earth has traced its course around the sun and once again on behalf of those who have to do with the making of Power I extend to all to whom these presents may come, our cordial wishes for a full measure of Christmas Cheer.

A curious cargo this old world carries over that orbit year after year.

Physically, its freight remains unchanged, but what of its personnel?

Are its inhabitants gaining wisdom with the passing years?

They are increasing their knowledge of the constitution and resources of the whirling globe upon which they live. They have subdued its forces and adapted its materials to their uses and abated the perils and rigors of their environment until they have arrived at a condition where mankind's worst enemy is man himself.

What would it mean, just in material well-being, to say nothing of psychical development, if the precepts announced twenty centuries ago by the Great Reformer whose birth we celebrate were universally practiced?

No war or fear of war; no crime or deprivation or oppression. His Kingdom on Earth.

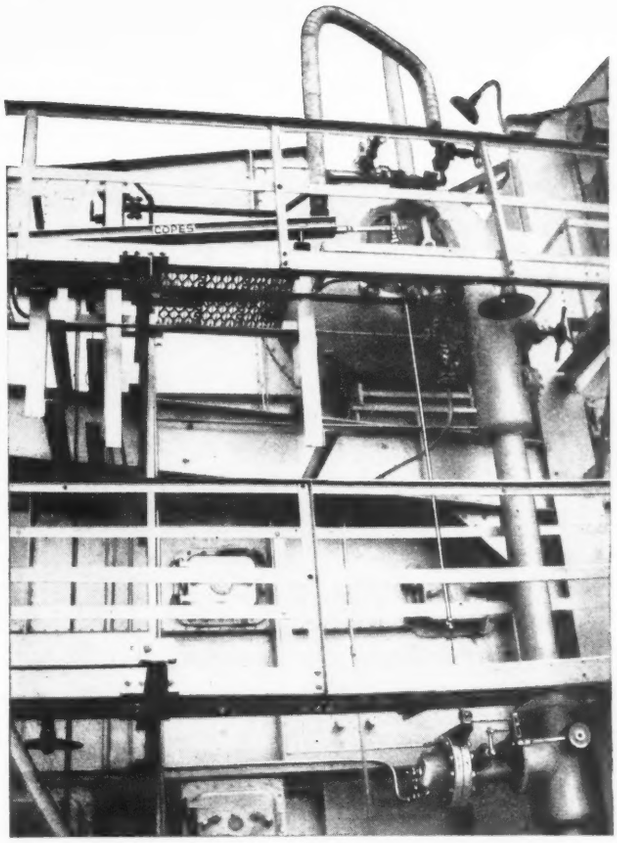
And the making of it in our hands.

F. R. Low

This prophetic Christmas greeting, first published in POWER for Dec 20, 1927, carries a message of real value to all of us today. One of Fred Low's famous forewords, it is a measure of the great man who wrote it.—*GEORGE EDWARDS*

At Fort Bend Utilities Company

This all-outdoor Riley Steam Generator carries a combined utility and sugar plant load. The steam demand fluctuates rapidly and over a wide range. The COPES Flowmatic Regulator, shown in the photograph, was installed and adjusted without need of factory service. There is an extreme water level variation of plus or minus one inch.



For Pressures from 80 to 1900 Pounds

In less than four years, over 300 COPES Flowmatic Regulators have been ordered for important utility and industrial plants. They are to operate at pressures from 80 to 1900 pounds gage—on boilers with steaming capacities from 15,000 to 650,000 pounds per hour. This is the widest, quickest acceptance ever gained by any steam-flow type feed water regulator.

FLOWMATIC helps get new boilers on the line..*quickly!*

ONE thing users like about the COPES Flowmatic is the way it swings into almost-perfect operation from the moment it is adjusted and cut into service. They say this simplified two-element steam-flow type feed water regulator is just about as easy to adjust and operate as a simple level control. They tell how the dependably accurate level control saves them time in getting new steam generating units on the line—because all their efforts can be devoted to coordinating other auxiliaries and controls for efficient plant operation.

Want to know how this new COPES operates—where it is used—what results others are getting in regular service? Then write for Bulletin 429—16 pages of informative illustrations and text.

NORTHERN EQUIPMENT COMPANY
1221 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR
FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

NEW CATALOGS, BOOKLETS, BULLETINS

For Your Convenience—Copies of the literature described on this and following pages may be obtained by filling out the business-reply cards on page 129

Over 350 items have been described, covering practically all equipment and supplies used by power engineers. So don't get worried if your requests fail to come back to you by return mail, because it will take two or three weeks at least to sort and classify the return cards. We have made our New Year's resolution in advance to get literature to you as quickly as possible

AIR-CONDITIONING

1 AIR CONDITIONING — Carbondale Div, Worthington Pump & Machinery Corp, Harrison, N. J. 28-page bulletin describes Carbondale equipment for buildings and institutions. Covered are air-conditioning units, refrigeration compressors, refrigeration condensers, deaerators, feedwater heaters, liquid meters, pumps, refrigerating units, room coolers, hot-process water softeners, etc.

2 AIR CONDITIONING — Frick Co, Waynesboro, Pa. 8-page bulletin No. 100-B explains with photographs and diagrams basic design, application, size, speed, etc of company's refrigerating machines.

BEARINGS

3 BEARINGS—R W Rhoades Metaline Co, Long Island City, N. Y. Catalogue No. 5 is arranged in three sections. One describes lubricating properties of Metaline; second outlines various types and range of application for oilless bearings; last part presents detailed data for use in preparing specifications.

4 PILLOW BLOCKS—Dodge Mfg Corp, Mishawaka, Ind. Bulletin A-401 describes and illustrates a new line of Sleevoil precision babbitted pillow blocks for industrial service, with engineering data.

5 BEARINGS — Keystone Carbon Co, Saint Marys, Pa. Revised edition describes properties and uses of self-lubricating bearings with details of installation. Also gives graphs showing allowances for press fit into housing and for running fit after installation.

6 BEARINGS—Bunting Brass & Bronze Co, Toledo, Ohio. 64-page industrial catalog No. 40 covers line of bearings and metals used for bearings. Covers industrial bearings, rates for special machining, groove types of bearings, oilless bearings, bronze bars, babbitt metals, electric-motor bearings, etc.

7 BEARINGS—Timken Roller Bearing Co, Canton, Ohio. 31-page book shows what steps have been taken by company to meet defense emergency, importance of Timken bearings and steel in machinery used for making defense equipment, and necessity for Timken products in defense machinery.

8 BEARINGS—Link-Belt Co, 307 N Michigan Ave, Chicago, Ill. 88-page data book No. 1775 describes complete line of "Friction Fighter" bearings. Complete tables of sizes, dimensions, weights and list prices given. Also included are tables of load ratings and minimum life expectancies, and other engineering information.

9 FLEXIBLE BEARINGS — Harris Products Co, 5408 Commonwealth Ave, Detroit, Mich. 4-page folder describes and illustrates Torflex flexible bearings. Advantages of their use, together with typical applications and method of construction, explained with photographs and line drawings.

10 BEARINGS—Keystone Carbon Co, St. Mary's Pa. 22-page catalog gives list of sizes and code numbers of Selflube bearings made by company. Installation instructions and various designs illustrated.

11 BEARINGS—New Departure Div, General Motors Sales Corp, Bristol, Conn. Vol. 1, 15th edition of handbook contains dimensions, load ratings, bearing fits, list prices of bearings made by company. Arranged in spiral-bound, loose leaf form, indexed for quick reference.

12 BEARING MATERIAL — Revere Copper & Brass, Inc, 230 Park Ave, New York, N. Y. 4-page folder describes Carbobronze bearing material, giving advantages, range of sizes, economical use, and instructions to be followed in machining.

13 BALL BEARINGS—Stephens-Adamson Mfg Co, Aurora, Ill. 32-page catalog No. 840 describes complete line of Sealmaster ball-bearing units such as pillow blocks, castings, flange-units, take-up units, hanger bearings, inter-ring bearings, and includes application, tolerances, life-expectancy tables, and dimensions of all types.

14 BRONZE BEARING — Johnson Bronze, 508 S Mill St, New Castle, Pa. 4-page illustrated folder describes new type pre-cast bearing, bronze-on-steel. Tells method of making bearings, which consist of bronze borings firmly bonded to strip steel. Advantages over ordinary bronze bearing cited.

BELTING

15 V-BELTS—Allis-Chalmers Mfg Co, Milwaukee, Wis. 8-page bulletin, B-6190, entitled "More Power to You" presents the points of difference in the latest Texrope V-belt, explains how Super-7 provides longer life and greater efficiencies because of 20% more and 50% stronger cords, new cushion rubber zone and duplex-sealed cover.

16 VULCANIZER—B F Goodrich Co, Akron, Ohio. Catalog section on Type RO portable vulcanizer for repairing covers of conveyor belts points out need that exists for such equipment.

17 SHEAVES—Allis-Chalmers Mfg Co, Milwaukee, Wis. 8-page bulletin B-6047 describes two types of V-Belt sheaves; Texsteel, the light heavy-duty sheave; and Texdrive, designed for rigidity against shocks, to provide a smooth, vibrationless flow of power.

18 RUBBER BELTING—B F Goodrich Milwaukee, Wis. 12-page bulletin, section entitled, "Selection and Maintenance of Rubber Transmission Belts," answers questions about rubber belting, covering type, grade, width, thickness, horsepower capacity and rating, length, belt joints, endless belts, importance of bearing capacity in applying rubber belts and many others.

19 STEEL BELT LACING—Bristol Co, Waterbury, Conn. Bulletin 731 gives information on typical applications, types and sizes available, together with prices applying. Shows how this type belt lacing is applied.

20 V-BELTS—Manhattan Rubber Mfg Div, Passaic, N. J. 4th edition of Condor V-Belt Engrg Data Book revised to include hp specifications recently adopted. Divided into two parts. First covers standard drives, while second has sheave factors and other data for designing new or special drives.

21 CONVEYOR BELT—B F Goodrich Co, Akron, Ohio. 4-page catalog section gives story of theories and principles

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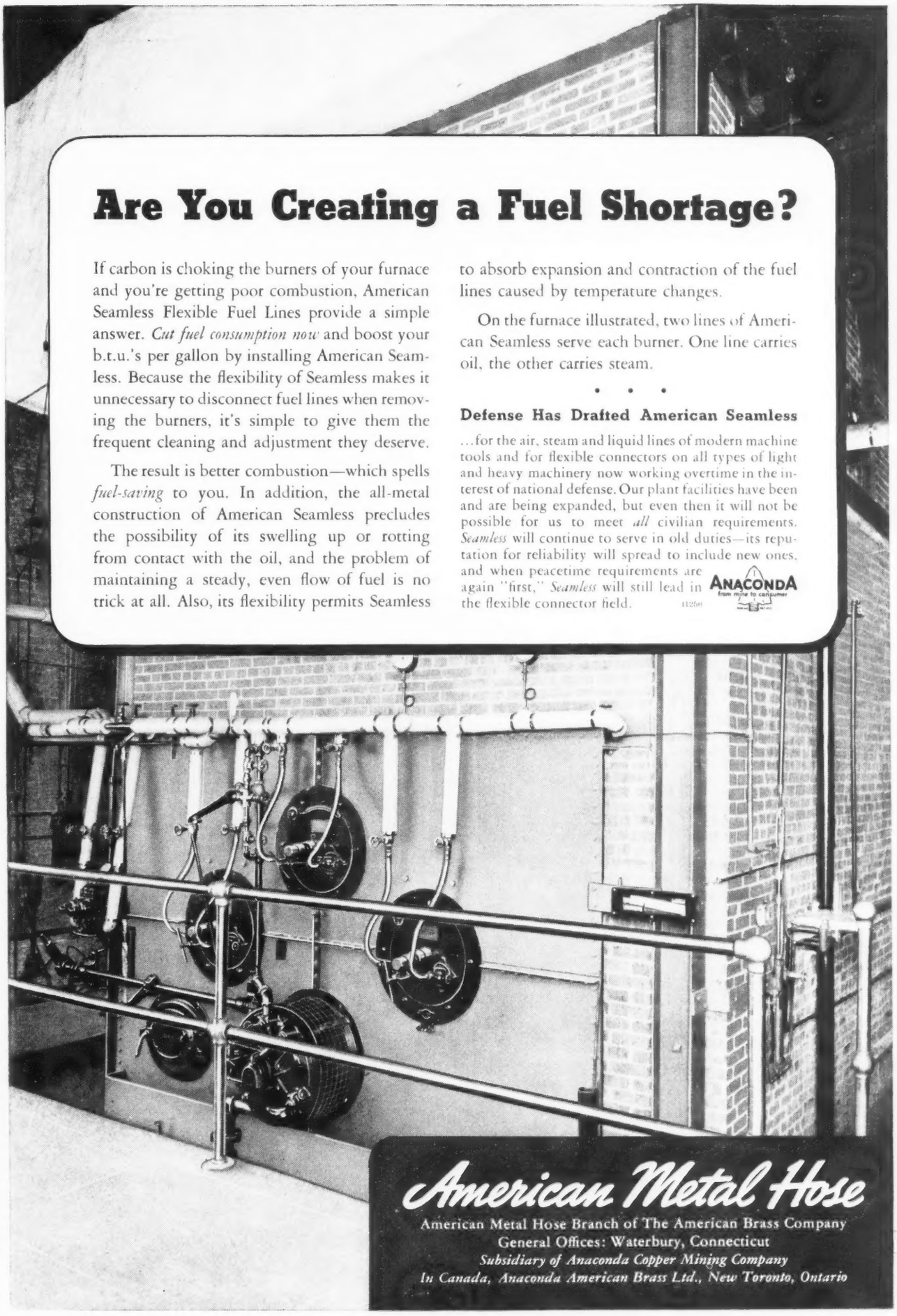


Are You Creating a Fuel Shortage?

If carbon is choking the burners of your furnace and you're getting poor combustion, American Seamless Flexible Fuel Lines provide a simple answer. *Cut fuel consumption now* and boost your b.t.u.'s per gallon by installing American Seamless. Because the flexibility of Seamless makes it unnecessary to disconnect fuel lines when removing the burners, it's simple to give them the frequent cleaning and adjustment they deserve.

The result is better combustion—which spells *fuel-saving* to you. In addition, the all-metal construction of American Seamless precludes the possibility of its swelling up or rotting from contact with the oil, and the problem of maintaining a steady, even flow of fuel is no trick at all. Also, its flexibility permits Seamless to absorb expansion and contraction of the fuel lines caused by temperature changes.

On the furnace illustrated, two lines of American Seamless serve each burner. One line carries oil, the other carries steam.

• • •

Defense Has Drafted American Seamless

...for the air, steam and liquid lines of modern machine tools and for flexible connectors on all types of light and heavy machinery now working overtime in the interest of national defense. Our plant facilities have been and are being expanded, but even then it will not be possible for us to meet *all* civilian requirements. *Seamless* will continue to serve in old duties—its reputation for reliability will spread to include new ones, and when peacetime requirements are again "first," *Seamless* will still lead in the flexible connector field. 11250

ANACONDA
from mine to consumer

American Metal Hose

American Metal Hose Branch of The American Brass Company
General Offices: Waterbury, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada, Anaconda American Brass Ltd., New Toronto, Ontario

underlying construction of cord conveyor belt, as well as some of outstanding results which were obtained through its use. Well-illustrated catalog shows cross section of belt construction.

22 V-BELT DRIVES — Fort Worth Steel & Machinery Co, Fort Worth, Texas. 64-page data book covers all types of V-belt drive applications, "Bolflex" multiple V-belts. Also has engineering data such as ratios, load capacities, etc.

23 CONVEYOR BELT—B F Goodrich Co, Akron, Ohio. 12-page booklet describes and illustrates how principle of present-day automobile tires was made practical in development of field splicing and vulcanizing cord conveyor belt. Physical advantages of cord belting discussed, together with adhesion, flexibility, mildew resistance, freedom from stretch and other engineering advantages.

24 V-BELTS—Manheim Mfg & Belting Co, Manheim, Pa. 24-page booklet gives graphic story of Veelos, adjustable V-Belt made by company. Various applications shown. Method of installation pictured, and advantages over other type belts given.

25 BELT HOOKS—Sawyer Belt Hook Co, Pawtucket, R. I. 5 catalog pages describe several products, including plate fasteners, button fasteners, belt hooks, wedges, hammers, mauls, etc., with prices applying.

26 BELTING—Alexander Brothers, 406 N Third St, Philadelphia, Pa. 32-page catalog, in question-and-answer form, concerns line of products made by company. Engineering tables and belt hints also presented.

27 V-BELTS—Dayton Rubber Mfg Co, Dayton, Ohio. 8-page booklet pictorially illustrates application of V-belts to the oil industry and shows results of seven years of belt testing.

28 BELTING—B F Goodrich Co, Akron, Ohio. 2-page leaflet discusses construction and advantages of Multicord belting, including application of Plylock splice to pulleys to make belts endless.

29 BELTING—Worthington Pump & Machinery Corp, Harrison, N. J. 4-page leaflet gives results of laboratory tests which show that belt-life decreases rapidly if less than the normal number of V-belts are used.

BLOWERS

30 BLOWERS — Roots - Connersville Blower Corp, Connersville, Ind. 8-page, 2-color folder, Bulletin G-70, covers briefly applications of complete line of products. Separate pages devoted to positive-displacement blower, positive gas exhausters and boosters, rotary-displacement meters, liquid and vacuum pumps, centrifugal blowers and exhausters, and inert-gas generators, while on back page is brief summary of applications for each piece of equipment, together with list of more detailed bulletins available.

31 BLOWERS — Roots - Connersville Blower Corp, Connersville, Ind. 6-page folder, Form No. R-5341, is devoted to discussion of positive displacement blowers for raw-water ice-plant service. Several installation views included, and curve illustrates volume and power-characteristics of positive-displacement blowers. Condensed selection-table covers capacities of various blowers listed.

32 TURBO-BLOWERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. Bulletin No. B-6104 on multi-stage turbo-blowers used in handling air or gas for applications such as blast furnace and converter blowing, gas boosting and exhausting, circulating gases and compressing refrigerants.

33 BLOWERS — Roots - Connersville Blower Corp, Connersville, Ind. 6-page folder covers applications of Victor-Acme blowers and gas pumps for use with oil- and gas-fired units. Contains comparative curve plate showing advantages of rotary positive type, etc.

BOILERS

34 BOILERS—Kewanee Boiler Corp, Kewanee, Ill. Circular No. 97.80k is excerpt from general catalog, and shows Type C boilers, with specifications tabulations and diagrams. Also covers boilers installed on typical jobs singly and in batteries with mechanical firing.

35 HRT BOILER—Combustion Engineering Co, Inc, 200 Madison Ave, New York, N. Y. Catalog No. HRT-11 gives details of design and construction of horizontal return tubular boilers, contains various setting drawings and tables of standard dimensions for both brick-set and steel-encased settings. Different methods of firing shown and installations illustrated.

36 BOILERS—Erie City Iron Works, Erie, Pa. 8-page booklet illustrates and describes Erie City V-L boilers, presenting construction, dimensions and applications.

37 BOILERS—National Radiator Co, 221 Central Ave, Johnstown, Pa. 64-page 1941 catalog illustrates and gives data on boilers and units for all fuels, with all information classified under types and sizes of boilers. Ratings and data on radiators, convectors, enclosures and hot-water heaters given.

38 BOILERS—Kewanee Boiler Corp, Kewanee, Ill. Catalog 80k is a condensation of data appearing in 16-page Catalog 88k; it includes specifications, cuts and diagrams of Square Type "R" boiler for heating large and moderate size homes and smaller buildings.

BOILER ACCESSORIES

39 STEEL TUBES—Babcock & Wilcox Tube Co, Beaver Falls, Pa. Bulletin TB-319 outlines, with photographs and schematic line diagrams, seamless tube manufacturing process; refinery and process industries' application of B&W seamless Croloy and other alloy tubes and pipe, applications of stainless-steel tubes and pipe, and mechanical tubing.

40 COAL CRUSHERS—McNally Pittsburgh Mfg Corp, 307 N Michigan Ave, Chicago, Ill. Bulletin No. 941 directs attention to latest improvement in company's stoker coal crushers; this is ratchet take-up which will adjust rolls while crusher is in operation, permitting adjustments without losing time or stoker coal tonnage.

41 OIL BURNERS—National Airoil Burner Co, 1284 E Sedgley Ave, Philadelphia, Pa. 8-page illustrated bulletin shows numerous applications of burners in industry, steamboats, public buildings, schools and churches. Other oil- and gas-burning equipment listed, with pictures.

42 HEAT EXCHANGERS—Alco Products Div, American Locomotive Co, 30 Church St, New York, N. Y. 4-page bulletin No. 1023 describes Alco heat exchangers, prefabricated piping and pressure vessels. Explains Alco triple-service.

42A DAMPERS—Heacon, Inc, 2nd & Luzerne Sts, Philadelphia, Pa. Bulletin BP-1 describes construction applications and advantages of its improved damper, including data on accomplished gains.

43 BOILER SEALING RINGS—George P Reintjes Co, 2517-19 Jefferson St, Kansas City, Mo. 4-page folder illustrates and describes Reintjes drum-sealing rings, used to prevent upper side wall infiltration around boiler drums. Typical side-wall installation shown, and description of insulated and air-cooled wall included.

44 GAS BURNER—Lee B Mettler Co, 406 S Main St, Los Angeles, Calif. 4-page illustrated bulletin F-2 describes automatic "entrained combustion" motorized-fan gas-burner assembly, with applications and mechanical and capacity details.

45 BOILER EQUIPMENT — Permutit Co, 330 West 42nd St, New York, N. Y. 8-page bulletin No. 2391 covers Permutit automatic continuous boiler-blowoff equipment. Tells why blowoff is necessary, points out shortcomings of old or intermittent controls and discusses several typical arrangements of modern continuous blowoff systems based on flash or non-flash, high- or low-heat level, single- or group-control operating characteristics.

46 COAL CRUSHER — McNally-Pittsburgh Mfg Co, 307 N Michigan Ave, Chicago, Ill. Bulletin No. 740 shows coal crusher and gives test charts with results of operation in crushing various types of coal.

47 HEAT EXCHANGERS—Heat Transfer Products, Inc, 90 West St, New York, N. Y. Bulletin No. 104-A describes company's "Leverlox" design for heat exchangers, both shell and tube type, and also covers new type atmospheric evaporator, incorporating self-sealing tube and other features.

48 GRATES—The McClave Co, Mill St, Allentown, Pa. 16-page booklet illustrates and describes all McClave products associated with hand-firing of solid fuels. Covers sectional-expansion boiler fronts, dead plates, ash clean-out doors, sidewall and sidewall observation doors.

CLUTCHES & COUPLINGS

49 MAGNETIC CLUTCHES — Stearns Magnetic Mfg Co, Milwaukee, Wis. 20-page catalog, #225 A, contains data on application of magnetic friction devices, with dimension drawings, tables of specifications and pictures of installations showing the adaptability of magnetic clutches and clutch-brake units for near or remote control in industrial use.

50 FRICTION CLUTCHES — Carlyle Johnson Machine Co, Manchester, Conn. Booklet shows single- and double-type clutches in four sizes, wet and dry plate. New features include units that can be assembled or taken apart.

51 MAGNETIC DRIVES—Electric Machinery Mfg Co, Minneapolis, Minn. Single-page leaflet covers E-M magnetic drive as applied to utility power plant in the South. Plant data given, as well as engineering facts on magnetic drive.

52 FLEXIBLE COUPLINGS — Falk Corp, Milwaukee, Wis. Bulletin 8100 illustrates and describes outstanding features of five types of Airflex couplings. Contains typical installation views and section on how to select couplings.

53 MAGNETIC PULLEYS — Stearns Magnetic Mfg Co, Milwaukee, Wis. 16-page catalog contains descriptive matter, illustrations and specifications on magnetic pulleys and magnetic pulley-separator units.

54 HYDRAULIC CONTROL — Reeves Pulley Co, Columbus, Ind. 6-page folder tells how hydraulic control can be used with Reeves variable-speed transmissions. Illustrates applications in textile industries, and tells how transmission operates.

55 HYDRAULIC DRIVE—Twin Disc Clutch Co, Hydraulic Div, Racine, Wis. Bulletin No. 132, 24 pages, outlines nature, design, performance, and applications of hydraulic clutches and hydraulic-torque converters, with photographs and diagrams.

COMBUSTION & OTHER CONTROLS

56 COMBUSTION CONTROL — Hagan Corp, 300 Ross St, Pittsburgh, Pa. Bulletin DR-39, 8-pages, contains explanations of combustion principles and functions of automatic control; descriptions and layouts of typical modern control installations for boilers using all types of fuels; and list of representative applications of company's equipment.

57 CONTROLS—Johnson Service Co, Milwaukee, Wis. 6-page folder sets forth reasons for using Johnson Duo-Stats for economy control of hot-water heating. It is stated that the heating effect is reduced, in proper proportion as outdoor conditions fluctuate from extremely cold to mild weather. Many charts and photographs are included.

58 CONTROLS—Boiler Room Equipment, Inc, 45 West 45th St, New York, N. Y. 4-page folder features the Holby tempering valve, automatic thermostatically operated water blending device, its application, description, temperature-range, functions, etc, with diagrams of typical horizontal and vertical installations. Also lists prices and shipping weights for six sizes.

59 CONTROLS — Field Control Div Boiler Room Equipment Inc, 45 West 45th St, New York, N. Y. 8-page booklet explains the need for draft control with emphasis on special features of company's line with diagrams, charts and photographs of typical installations.

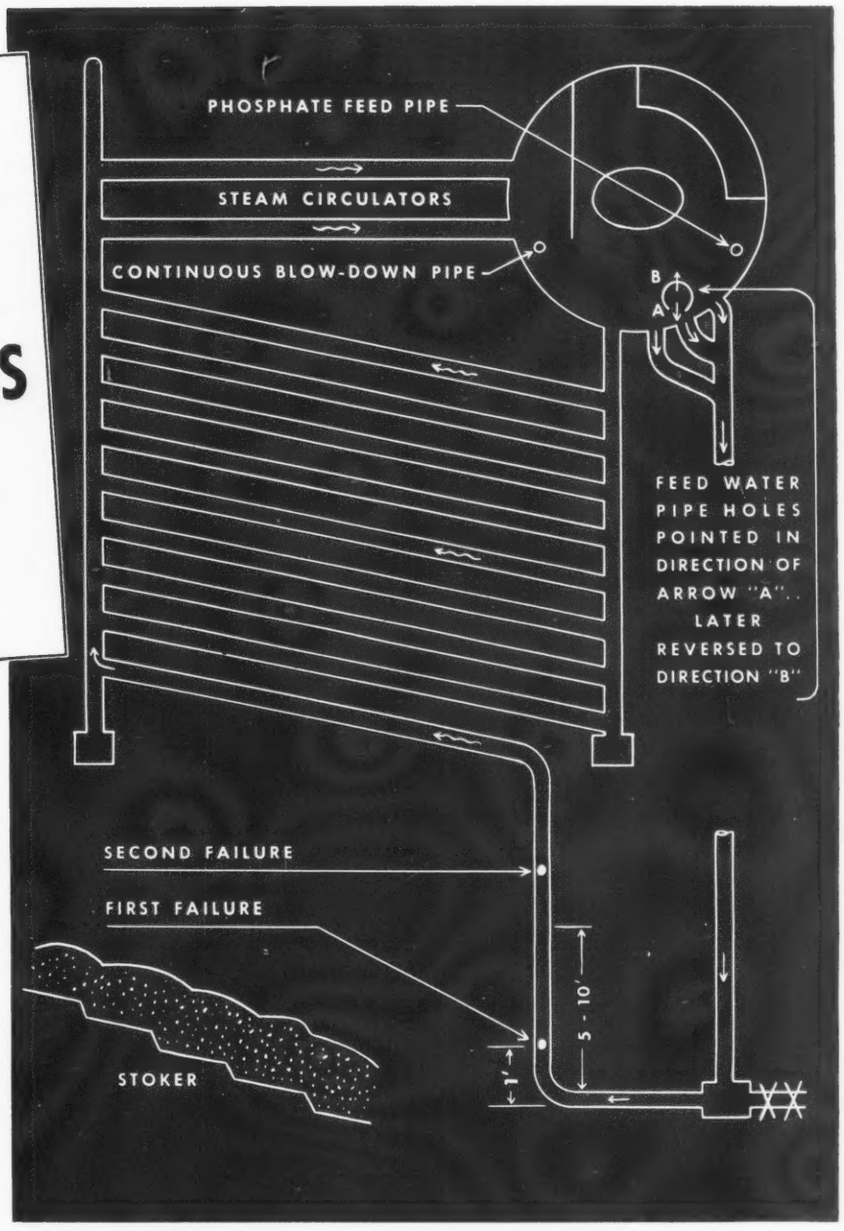
60 CONTROLS—Boiler Room Equipment Inc, 45 West 45th Street, New York, N. Y. 6-page folder covers Sentry smoke controls and combustion indicators which are said to increase efficiency and eliminate smoke.

61 CONTROLS—McDonnell & Miller, Wrigley Bldg., Chicago, Ill. 8-page pocket-size folder describes safety valves for boiler-water level control for every make and size of heating boiler with any type of firing; also covers service range and all application of equipment.

62 REGULATORS—Alexander Milburn Co, 1410 W Baltimore St, Baltimore, Md. Special portfolio describes Milburn gas and air regulators, both single and 2-stage, ball-seat type.

63 SPEED CONTROL—Reeves Pulley Co, Columbus, Ind. 24-page illustrated booklet entitled, "How to Speed Up Production with Variable Speed Control" cites 36 specific examples in all industries in which speed control has made

NEW BOILER BURNS OUT TWICE IN 6 WEEKS ...WHY?



WHY should a new boiler rated at 65,000 lbs. of steam per hour and 420 lbs. pressure burn out 4 tubes low down in the rear water wall during the first month? First thought—maybe it was too frequent blowdown of the rear water wall.

Then why, after locking the blowdown connections and welding in new tube sections, should seven tubes fail higher up within just two weeks of operation?

Was it caused by untreated water reaching the affected tubes? The plant staff didn't think so. Their tests showed nothing wrong. The boiler drum and visible tubes were clean as a whistle.

Having done what they could, they sent for a Hall Service Engineer. His examination showed no unusual conditions in tubes or drum. The boiler was in excellent shape. Then a section of one of the bagged tubes was cut out. In this was found an extremely thin, brittle coating of a gravish crystalline scale. Analysis showed largely calcium sulphate and a small amount of calcium carbonate. That could mean only one thing — untreated water *was* reaching the affected tubes. But how?

He inspected the drum again. This time he noted that the holes in the boiler feed pipe were directed downward. If untreated feed water was reaching the tubes, this was a way it could do it.

Then he checked the boiler blueprints. Sure enough, the feed holes should have been directed upward. Here was the needle in the haystack. He rotated the pipe 180°. That was months ago. There has been no more trouble with burnt out tubes.

There you have another of the thousands of cases where a Hall Engineer working with the plant staff keeps boilers on the line, another proof of the value of expert engineering knowledge in connection with water conditioning service.

Never has a protective boiler water conditioning service of this kind meant more to you than now. Why not ask us to explain it to you?

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

HALL SYSTEM *of Boiler Water Conditioning*

definite production increases and advantages possible. In addition to case histories, descriptions and illustration of Reeves speed control units are given, with different types of controls available.

64 CONTROLLERS—Brown Instrument Co, Philadelphia, Pa. 36-page catalog No. 8903 includes interior and exterior views of instruments, including operating parts, schematic diagrams showing principle of operation, "Indexet" mechanism, non-bleed booster pilot, etc.

65 CONTROLLERS—Bristol Co, Waterbury, Conn. 32-page catalog 4050 contains useful engineering information on theory and practice of modern automatic control of temperature, pressure, vacuum, flow, flow ratio, draft, humidity, liquid-level, pH value and time program. Line drawings show principle of operation and method of installation.

66 COMBUSTION CONTROL — Hagan Corp, Pittsburgh, Pa. 12-page bulletin features automatic combustion control as applied to larger steam-generating plants. Also contains complete explanation of combustion principles, functions of and need for automatic control; descriptions and layouts of typical control-installations for boilers fired by all types of fuels.

67 VOLTAGE REGULATORS — Allis-Chalmers Mfg Co, Milwaukee, Wis. Bulletin B-6137 covers Type VD rocking-contact voltage regulators. Well-illustrated booklet shows how regulators may be applied to dc problems in steel and paper mills, electro-plating and chemical plants and in process industries.

68 REGULATORS—Chaplin-Fulton Mfg Co, 28-40 Penn Ave, Pittsburgh, Pa. 12-page bulletin No. 130 describes and illustrates regulators for compressor control. Several types covered, including pilot-operated, weight-and-lever operated, and spring-operated units. Diaphragm dimensions given for various models.

69 PRESSURE REGULATORS — Mason-Neilan Regulator Co, 1190 Adams St, Boston, Mass. 68-page catalog No. 69 describes complete line of "Mason-Neilan" regulators, giving photographs of each, maximum capacities, list prices and shipping weights. Construction, operation, uses and advantages also presented.

70 AUTOMATIC CONTROLLERS — Fisher Governor Co, Marshalltown, Iowa, 175-page spiral-bound book covers automatic controllers, governors, auxiliary-pressure regulators, liquid-level controllers, lever valves, accessories, etc.

71 FIELD FREQUENCY CONTROL—Electric Machinery Mfg Co, Minneapolis, Minn. 8-page publication No. 159 illustrates and describes automatic control for generators and synchronous motors. Advantages listed, and other types of equipment covered, such as part-winding control, reduced-voltage control, and live-front control. Outline dimensions listed, as are suggested specifications.

72 REGULATORS—Atlas Valve Co, Newark, N. J. 6-page folder points out features of company's regulators. Also gives a typical water-low chart and list of representative users.

73 AUTOMATIC CONTROLS—Askania Regulator Co, 1603 S Michigan Ave, Chicago, Ill. Booklet entitled, "Stability of Automatic Control Equipment" discusses causes and evils of "hunting", overshooting and undershooting that results when time lag is introduced. Shows how problem can be basically corrected without any sacrifice of sensitivity.

74 COMBUSTION CONTROL — A W Cash Co, Decatur, Ill. 12-page bulletin 300 presents three simple steps of combustion control. Sections on which combinations of controllers to use if coal is burned are put across by schematic diagrams, while similar layouts are used to show applications if oil or gas is burned.

75 PRESSURE REGULATORS—Foster Engineering Co, 109 Monroe St, Newark, N. J. 8-page catalog section, Bulletin 7, describes and illustrates Foster Y-type pressure-reducing regulators for steam, air, liquids and gases.

76 CONTROL THERMOMETER — Wheelco Instruments Co, S Halsted St, Chicago, Ill. 12-page Bulletin No. G502-2 covers Wheelco "Therm-Otrol," industrial-recording control thermometer. Descriptions of operation, features, and other types of equipment also included. Operating diagrams shown, suggesting hookups using Wheelco instruments.

COMPRESSORS & ACCESSORIES

77 COMPRESSORS — Chicago Pneumatic Tool Co, 6 East 44th St, New York, N. Y. Second edition of 20-page bulletin, No. 766, is replete with photographs and diagrams of company's line of heavy-duty, double-acting "package type" stationary compressors and accessory parts.

78 COMPRESSORS—B F Sturtevant Co, Boston, Mass. 20-page catalog No. 458, covers basic principles and important phases in design, construction and application of large-volume, high-pressure centrifugal compressors. Also includes methods of drive, lubrication and control, together with factors involved in effecting power economies, wide range of volumes at constant pressure and quiet operation with minimum maintenance cost.

79 REFRIGERATION COMPRESSOR —Worthington Pump & Machinery Co, Harrison, N. J. 6-page folder illustrates and describes centrifugal liquid-cooling systems. Separate parts are described, such as compressor and controls, driving motor, etc.

80 COMPRESSORS — Pennsylvania Pump & Compressor Co, Easton, Pa. Bulletin No. 192, 24 pages, describes horizontal, duplex, double-acting, water-cooled air or gas compressors for either single or 2-stage compression, with photographs and diagrams. Also outlines new control method.

81 COMPRESSOR SELECTOR—Quincy Compressor Co, Quincy, Ill. Selector functions like a slide rule; shows correct compressor model number, free-air delivery, rpm, piston displacement, and motor hp required for various jobs.

82 COMPRESSOR — Bury Compressor Co, Erie, Pa. 16-page bulletin 426 describes construction, features and accessories of steam-driven air compressor, with cross-sectional views and photographs.

83 COMPRESSORS — Schramm, Inc, West Chester, Pa. 2-page leaflet illustrates and describes different types of portable compressors. Specifications for each model included, together with dimensions, weights and prices.

84 COMPRESSORS — Pennsylvania Pump & Compressor Co, Easton, Pa. 4-page bulletin No. 195 illustrates, describes and gives typical applications of air and gas compressors made by company. Important characteristics and general features listed.

85 ENGINE-COMPRESSOR — Worthington Pump & Machinery Corp, Harrison, N. J. 18-page bulletin S-550-B-19 shows with photographs and diagrams basic design and practical applications of engine-compressors in refineries, refrigeration plants, sewage works, etc.

CONDENSERS & ACCESSORIES

86 CONDENSER REPAIRS—C & C Corp, 381 Fourth Ave, New York, N. Y. 4-page bulletin No. C-41 describes, illustrates, and points out advantages of C & C method of condenser tube pulling, stretching and cutting. Line drawings clearly show procedures involved.

COOLING TOWERS & SPRAY EQUIPMENT

87 WATER COOLERS — Fairbanks, Morse & Co, 600 South Michigan Ave, Chicago, Ill. 16-page booklet FECD describes F-M evaporative closed-system water coolers for diesel engines, designed primarily for indoor operation. Types A, B, & C are covered and illustrated.

88 WATER-CONSERVATION EQUIPMENT—Water Cooling Corp, 71 Nassau St, New York, N. Y. Catalog describes company's line of mechanical draft cooling towers, atmospheric cooling towers, spray-nozzle cooling systems and roof cooling systems. Schematic diagrams and photographs illustrate principles involved in new roof cooling plan.

89 JACKET WATER COOLERS—Condenser Service & Engrg Co, Inc, Hoboken, N. J. 8-page colored folder gives construction details, diagrammatic layouts, etc, for diesel jacket-water coolers.

90 NOZZLES—Spraying Systems Co, Chicago, Ill. Catalog No. 21 describes and illustrates complete line of spray nozzles for all industrial uses; also contains performance tables and data sheets.

DIESELS & ACCESSORIES

91 DIESELS—Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill. 80-page booklet pictorially illustrates company's stationary diesel installations in municipal and industrial plants; lists equipment used and typical annual earnings resultant. Also contains map of the United States which locates many hundreds of Fairbanks-Morse publicly owned diesel installations.

92 DIESELS — National Supply Co, Superior Engine Div, Springfield, Ohio. 16-page Bulletin No. 137 discusses 4-cycle, vertical, cold-starting stationary diesel engines, 12x15, with many illustrations of the engines and their parts. Also contains photographs of typical installations.

93 DIESEL LUBRICATION — Standard Oil Co of N. J., 26 Broadway, N. Y. 16-page booklet describes properties of high-stability, high-viscosity detergent-type oil for heavy-duty gasoline and diesel engines. Explains special laboratory and engine tests oil was put through, and includes photographs of engine parts.

94 DIESEL ENGINES—Lorimer Diesel Engine Co., Oakland, Calif. 4-page, 2-color folder illustrates and describes various types of Lorimer diesels, giving applications of engines in different parts of the world. Stationary, marine and natural-conversion engines covered.

95 DIESELS—Cooktite Ring Sales Co, 1737 Howard Ave, Chicago, Ill. Bulletin No. 4-641 entitled, "50 to 75% Less Cylinder and Ring Wear", shows how to arrive at cost of cylinder and ring wear in all makes of Diesel engines. Also standardizes methods of arriving at average cylinder-wear figures.

96 DIESELS—Caterpillar Tractor Co, Peoria, Ill. 36-page, 2-color catalog lists more than 50 products made by company. Sections devoted to track-type tractors, diesel and natural-gas engines, diesel marine engines, diesel automotive engines, and diesel and natural-gas electric sets. Form 6425.

97 DIESEL MANUAL—Cummins Engine Co, Columbus, Ind. 65-page manual lists types of engines, and gives information on care of engines in general. Lists troubles, causes and remedies, and gives instructions for assembling and disassembling different engine parts. Complete owner's manual.

98 ELECTRIC SETS—Caterpillar Tractor Co, Peoria, Ill. 8-page booklet, "Power for Industrial Plants", portrays diesel-engine and electric installations producing all power needed on full-time jobs, serving as a power auxiliary and as standby units.

99 EMERGENCY POWER UNITS — Bardco Mfg & Sales Co, 4301 Goodwin Ave, Los Angeles, Calif. 8-page catalog shows various types of gasoline, natural gas and diesel-engine driven generating plants used for different standby services. Plants require only three seconds between load failure and automatic pickup.

100 DIESEL MODERNIZATION — Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill. 12-page Bulletin "Modernizing Your Diesel" tells F-M diesel owners how they can modernize their present diesels with change-over parts. Photographs and drawing show how diesels look before and after modernization, while testimonials add to records showing advantages in change-over.

101 DIESELS — Caterpillar Tractor Co, Peoria, Ill. 16-page booklet contains photos and testimonials of Caterpillar Diesel owners. Brief statements concerning operating results are included, together with photos of plant owners and engines.

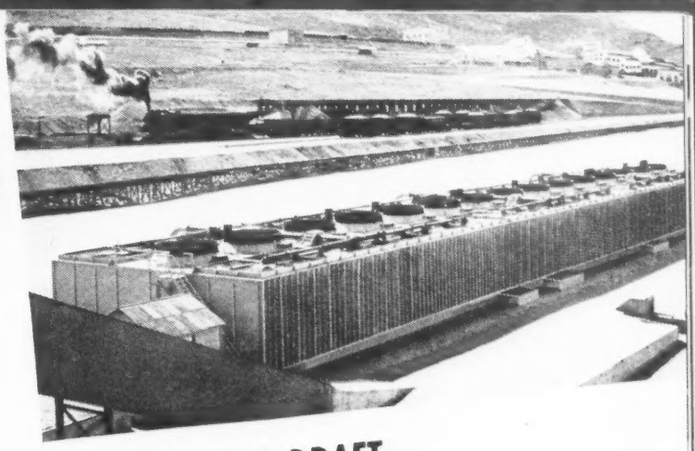
102 PRECISION EQUIPMENT — Caterpillar Tractor Co, Peoria, Ill. Bulletin entitled "How Precision Insures Caterpillar Quality," takes reader into laboratories of company and shows where and how precision parts, such as diesel fuel injection nozzles, among others, are made. Also discusses construction and testing of other parts.

103 PISTON RINGS—Cooktite Ring Sales Co, Chicago, Ill. 8-page booklet features questions and answers on piston rings with emphasis on fact that special ring-design can prevent blow-by.

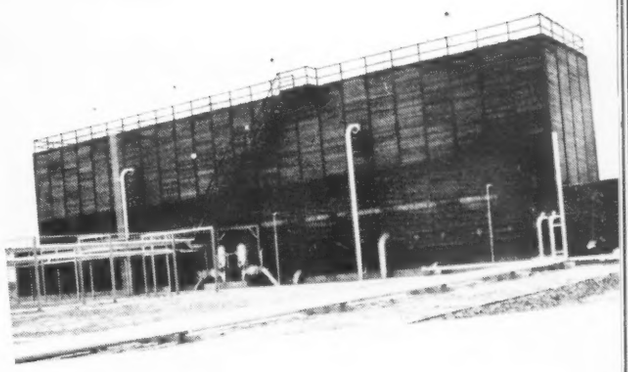
104 DIESELS — R H Sheppard Co, Hanover, Pa. 4-page folder gives features, advantages, and comparative costs of Sheppard diesel-electric package

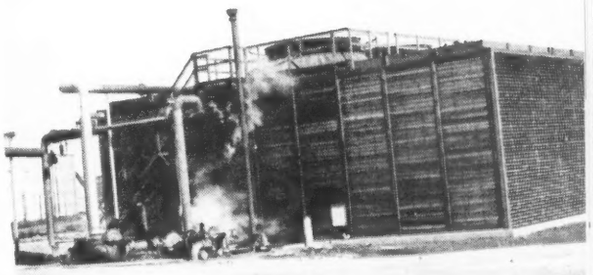
PERFORMANCE *is the Final Test of Value*

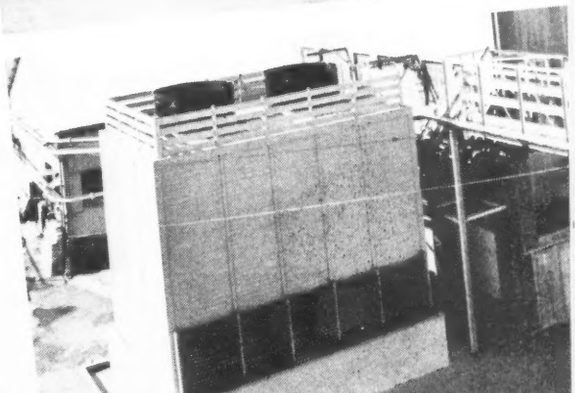
So Look at the PERFORMANCE RECORDS



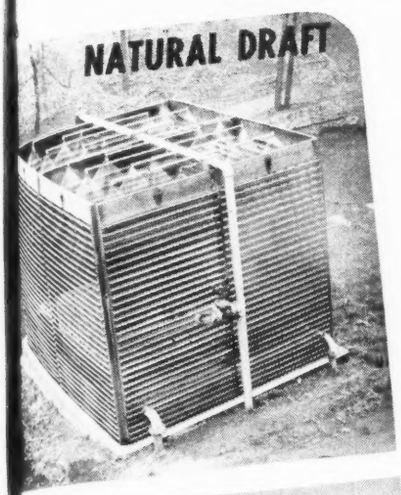
MECHANICAL DRAFT

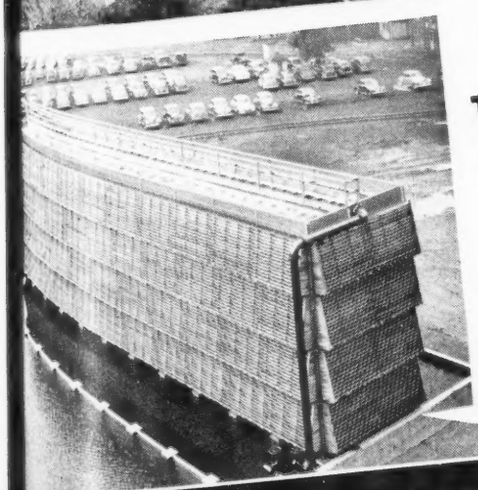






NATURAL DRAFT





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are saving money and promoting efficiency in plants, smallest to largest, in all phases of industry

plants. Engine specifications of Model 6 included.

DUST COLLECTION

105 DUST COLLECTORS—American Foundry Equipment Co, Mishawaka, Ind. 12-page booklet tells reasons why dust conditions in plant should and can be properly controlled with American dust collecting equipment; three types described: "Dustube" dust collector, high-efficiency cyclone dust collector, and wet disposal unit.

106 DUST COLLECTORS—Pangborn Corp, Hagerstown, Md. 6-page folder describes operation of unit-type dust collector with typical installations and photographs of individual parts.

107 STACKS—Prat-Daniel Corp, Port Chester, N. Y. 12-page catalog No. 109 covers various types of Thermix stack installations, including dust-collector stacks, recirculator stacks and fans, Multicyclones, and others.

ELECTRICAL METERS & INSTRUMENTS

108 FITTINGS — Thompson Electric Co, Cleveland, Ohio. Catalog No. 41, 40 pages, gives information on hangers, shock absorbers, suspension devices, accessories and electrical fittings; presents practical applications.

109 TRANSFORMERS — Westinghouse Elec & Mfg Co, Dept 7-N-20, East Pittsburgh, Pa. Booklet B-2304 answers questions about advantages, safety features, design, size and weight, maintenance and application of air-cooled transformers for factories, mines, and central stations.

110 CIRCUIT BREAKERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 4-page folder No. B6129 describes Types, DZ-60A, DZ-100A, and DZ-200A oil circuit-breakers, for 200 amp or less, 15,000 volts, up to 500,000 kva interrupting capacity. All parts of breaker shown separately, with brief description of each.

111 TRANSFORMERS — Westinghouse Electric & Mfg Co, East Pittsburgh, Pa. 16-page descriptive data 211 describes CSP self-protecting power transformers. Advantages of unit-substation transformers explained with special reference to reliability, flexibility and cost per kva installed. Four pages of application data include diagrams of different distribution arrangements.

112 TEST SET—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa. Catalog E-54(4) covers bushing test-set, for measurement of power factor and capacitance of installed bushings and insulators. Also includes other information about L & N equipment.

113 FUSE CUTOUTS—Schweitzer & Conrad, Inc, 4435 Ravenswood Ave, Chicago, Ill. 32-page bulletin 215 describes complete line of S & C fuse cutouts, including open and closed types, as well as light, medium, and heavy-duty cutouts.

114 ELECTRIC EQUIPMENT—Howard B Jones, 2300 Wabansia Ave, Chicago, Ill. 20-page catalog No. 11, illustrates and describes complete line of multi-contact plugs and sockets, terminals, terminal panels, fuse-mounts, etc.

115 TRANSFORMERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 16-page bulletin No. B-6152 covers transformers for secondary ac network systems, including outline sketches, installation and shop assembly views, and construction details of standard and special-network transformers.

FILTERS

116 STEAM SCRUBBER—Bradshaw & Co, 530 Fourth Ave, Pittsburgh, Pa. Pamphlet No. 688 gives design, operation and purposes of W-K-M Master Steam Scrubber, for use with engines, turbines, pumps, refineries, etc., wherever live or exhaust steam is used.

117 FILTERS—S G Frantz Co, New York, N. Y. 8-page leaflet contains information on FerroFilters, oil filters that magnetically remove iron and steel particles from suspension in liquids. Also lists comments of typical users.

GASKETS & PACKING

118 GASKETS — Goetze Gasket & Packing Co, New Brunswick, N. J. 60-page catalog presents swift picture-trip through plant, showing laboratories and shops, and gives complete information on all types of gaskets and packings made by company.

119 PACKINGS — Johns-Manville, 22 East 40th St, New York, N. Y. Illustrated catalog contains service recommendations on J-M packings and gaskets. Also includes guide to proper packing selection for various services under such conditions as steam, brine, ammonia, acids, caustics and oils.

120 FELTS—Felters Co, Inc, 210 South St, Boston, Mass. Comprehensive handbook on felt seals for lubricants, contains handy specifications, information and details.

121 PACKINGS—J E Rhoads & Sons, 35 N Sixth St, Philadelphia, Pa. 3-page folder compares Tannate leather packings with ordinary leather ones, presenting advantages and answering questions concerning same. Types of shapes available shown with line drawings.

122 PACKING COMPOUND — Collins Packing Co, 401 N Broad St, Philadelphia, Pa. 4-page folder describes Colinite compound No. 3, for application to hydraulic plungers, rams, valve stems, etc, against acids, air, ammonia, steam, water, etc, to reduce friction and wear.

122A PACKING—Greene, Tweed & Co, 4377 Bronx Blvd, New York, N. Y. 12-page pocket-size booklet entitled "Packing for Power and Process Plants" describes several types of industrial packing with photographs and diagrams.

GEARS, PULLEYS & CHAIN DRIVES

123 GEAR APPLICATIONS — Ampco Metal Co Inc, Milwaukee, Wis. 6-page bulletin, "Ampco Metal In Gears", discusses use of Ampco metals in gear applications. Also shows case histories, contains a chart showing physical properties of Ampco grades best-suited for gear service.

124 GEARS—Link-Belt Co, 600 S Michigan Ave, Chicago, Ill. 52-page catalog and data book No. 1874 gives speeds, torque ratings, dimensions, weights, and other data for all seven sizes of the Link-Belt P. I. V. gear variable-speed transmission. Units of ½ to 15 hp capacity, with speed ratios of up to 6 to 1 are tabulated, and illustrated.

125 GEARING — Michigan Tool Co, 7171 East McNichols Rd, Detroit, Mich. 44-page spiral-bound book, CW-41-A, covers design characteristics, applications, tool and horsepower rating charts now available. Also lists standards for worms, bearing carriers and caps, gears and spiders.

126 SPEED TRANSMISSIONS—Graham Transmissions, Inc, 2711 N 13th St, Milwaukee, Wis. Manual 501 includes principles of metallic traction and description of reversing feature found on some Graham transmissions, together with complete data on variable-speed transmissions made by company.

127 VARIABLE-SPEED DRIVE—Reliance Electric & Engrg Co, Ivanhoe Rd, Cleveland, Ohio. 8-page folder describes and illustrates all-electric, adjustable-speed drive for ac circuits, made now in smaller sizes, and popularly priced. Applications shown, with corresponding advantages for each.

128 REDUCTION DRIVES—American Pulley Co, Philadelphia, Pa. 40-page loose-leaf folder presents complete story of American reduction unit, with fixed ratio of 13 to 1. Typical application hookups shown, and vital engineering data on how to select unit, dimension tables, etc, included.

129 GEARS and CHAINS — Atlantic Gear Works, 204 Lafayette St, New York, N. Y. 1941 general catalog describes stock gears, sprockets and chains, reducers, bearings and couplings. Also included are specifications and prices of pinion rods, racks, ratchets, internal gears, special gears, spiral and helical gears, worm gears, bevel and miter gears and other products. Special supplement lists types of equipment available for special work.

130 GEARS — Westinghouse Elec & Mfg Co, East Pittsburgh, Pa. 8-page booklet describes coupled reduction gears for driving compressors, line shafts, etc. Cross-sectional drawings show position of important parts and physical dimensions.

131 VARIABLE-SPEED DRIVES — Electric Machinery Mfg Co, Minneapolis, Minn. "Magnetic Variable-Speed Drives" is 12-page publication which presents principles, characteristics, advantages, and constructional forms of magnetic drives.

132 CHAIN DRIVES—Link-Belt Co, 307 N Michigan Ave, Chicago, Ill. 4-page folder No. 1894 covers 3/16-in.-pitch "Silverstreak" silent-chain drives. Horsepower per inch of chain width, pitch diameters of wheels, and list prices of both chain and wheels given in tabular data.

133 VARIABLE-SPEED PULLEYS—Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill. 24-page catalog presents new Ideal products, including variable-speed pulleys, live centers, armature and stator holder, electric etchers, flashlight storage battery, and others.

GENERATORS & ACCESSORIES

134 TURBINES—General Electric Co, Schenectady, N. Y. 78-page spiral-bound handbook describes turbine-generators from 500 to 7500 kw; contains photographs and charts showing major steps in turbine-generator manufacture; sectional view of turbines, valve mechanisms, generators, exciters and ventilation; detailed sketches of various turbine types, together with reference charts of turbine steam rates.

135 GENERATORS — Burke Electric Co, Erie, Pa. 4-page illustrated folder describes ac synchronous generators for diesels. Stator described in detail, as is rotor, with cross sections. Brief item on Burke exciters included.

HEATING & VENTILATING EQUIPMENT

136 UNIT HEATERS—L J Wing Mfg Co, 154 W 14th St, New York, N. Y. 16-page book gives a history of the development and progress of industrial plant heating with emphasis on the company's line of revolving unit heaters. Also contains many photographs of actual installations.

137 UNIT HEATERS—McQuay Inc, 1600 Broadway N E, Mineapolis, Minn. Bulletin No. 751, 8 pages, features McQuay radial unit heaters, their design and construction details. Numerous tables and diagrams furnish data such as steam capacities and specifications, air travel, hot-water capacities, pressure drop in feet of water, with wiring and piping diagrams.

139 HEATING—McClave Co, 751 Mill St, Allentown, Pa. 4-page circular tells how McClave grates of various types combine with forced draft equipment and automatic controls for all types of heating jobs.

140 UNIT HEATERS — McQuay Inc, 1600 Broadway N E, Minneapolis, Minn. 8-page bulletin, No. 746, includes engineering data in tabular form and line diagrams on McQuay down-flow unit heaters for factories, warehouses, stores, offices, garages, etc. Also contains illustrations of the heaters, with and without anemostats and diffusers.

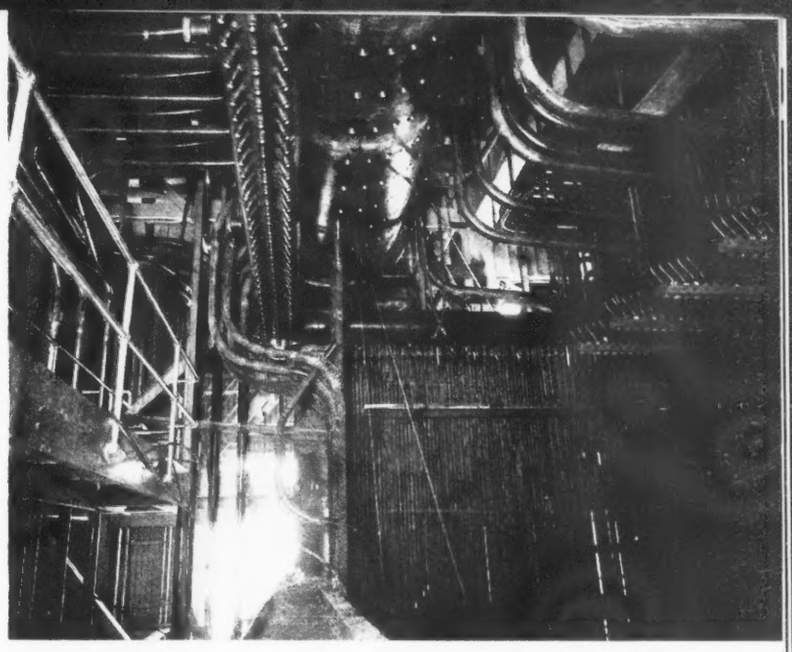
141 UNIT HEATERS — Modine Mfg Co, Racine, Wis. 32-page illustrated catalog No. 140-E includes discussion of modern industrial heating and unit-heater design. Covers Modine line of horizontal-delivery unit heaters including complete engineering data, information on location and installation of unit heaters.

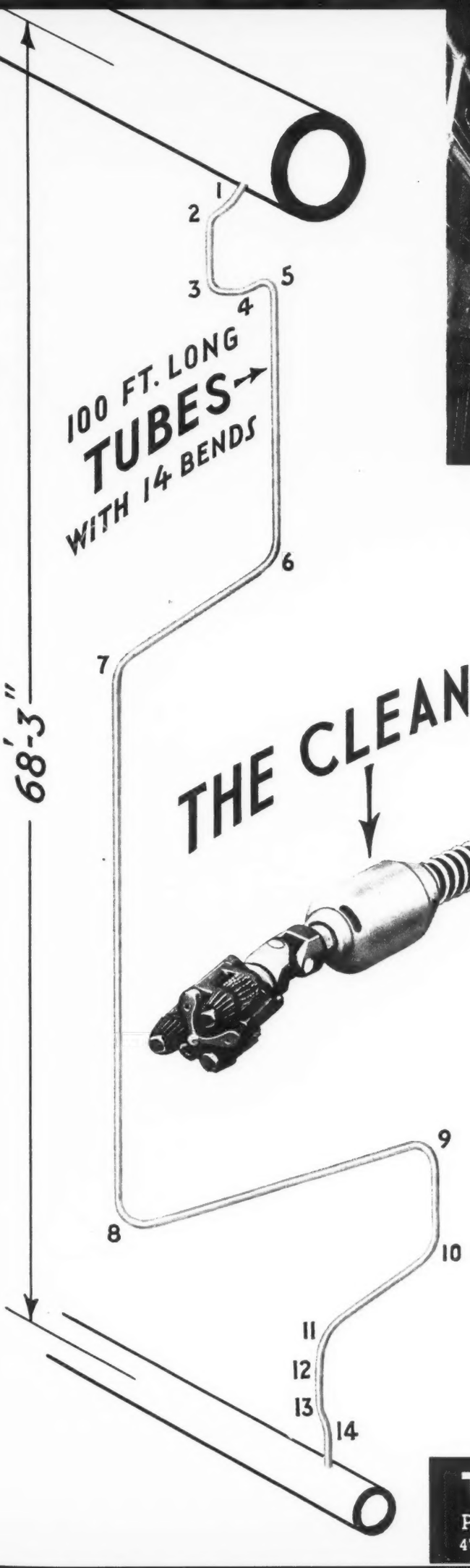
142 UNIT HEATERS—Young Radiator Co, Racine, Wis. 16-page catalog No. 2541 describes unit heaters for many uses, with photographs of typical installations. Also contains miscellaneous data, including steam-capacity tables for low-temperature units, and variable- and constant-speed motor-driven unit heaters.

143 UNIT HEATERS—B F Sturtevant Co, Hyde Park, Mass. 16-page bulletin No. 454 covers downblast speed heaters, giving features, capacity tables, mounting-heights and floor-coverages. Installation diagram for two typical types of buildings shown.

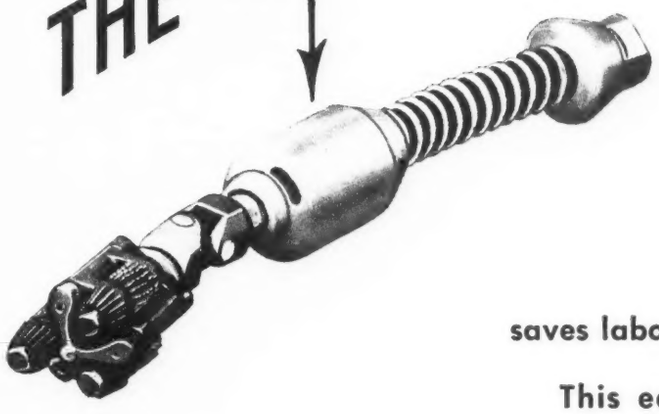
INSULATION

144 INSULATION—Ohio Brass Co, Mansfield, Ohio. 160-page catalog lists materials for transmission lines, distributing lines and substations, including strain insulators, suspensions and strain clamps, oil-filled and dry-type apparatus bushings, pincap and post-type station insulators, and many others.





THE CLEANER



Wilson engineers have designed special equipment which permits the cleaning of vertical tubes over 100 feet long and with *fourteen* bends (some of them 90° bends) without pulling hose and cleaners out at the bottom of the tubes and carrying them back to the top of the boiler to clean the next tube. This saves labor, time, and money.

This equipment, and Wilson Tube Cleaners and accessories, are used to clean the 2600 lb. pressure B. & W. Boiler in the Twin Branch Generating Plant of the Indiana and Michigan Electric Company, at Mishawaka, Indiana.

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PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

145 INSULATION — Union Asbestos and Rubber Co, Cicero, Ill. 4-page leaflet describes Unibestos, insulating material for high-temperature service with emphasis on structural strength of material that can support a large pipe. Also contains data for figuring average insulating-job costs and materials.

146 INSULATING VARNISH—Irvington Varnish & Insulator Co, Irvington, N. J. 34-page manual describes all varnishes, usually required, based on their relative importance in terms of extent and variety of use. Subject matter covers 31 different Harvel and Irvington insulating varnishes, paints and enamels, giving characteristics, uses, and applications of each.

147 ASBESTOS—Keasbey & Mattison, Butler Pike, Ambler, Pa. 32-page illustrated catalog covers K & M "Century" asbestos corrugated for building construction. Advantages and applications included, together with specifications of main sections and accessories.

148 INDUSTRIAL PRODUCTS — Johns-Manville, Inc, 22 E 40 St, New York, N. Y. 52-page illustrated catalog contains information and recommendations on high- and low-temperature insulations for every industrial need from 400 F below zero to 2500 F above. Data also included on refractories and castables, built-up roofs, electrical conduit, packing and gaskets.

LUBRICATING EQUIPMENT

149 LUBRICATION HANDBOOK — Valvoline Oil Co, 547 East Fifth St, New York, N. Y., offers oil and grease recommendation for all automotive units including aviation, industrial, marine, motor-bus and motorcycle. Also features tables of passenger-car models, 1937-1942.

150 LUBRICATION — Farval Corp, 3293 East 80th St, Cleveland, Ohio. 8-page bulletin describes Farval centralized system of lubrication; illustrates component parts, and charts twelve distinct savings said to be effected by the system.

151 LUBRICATION MANUAL — Gits Bros Mfg Co, 1846-66 S Kilbourn Ave, Chicago, Ill. 172-page catalog, contains information on lubrication and proper selection and use of lubricating devices. Also includes special sections on wick feed, constant level, and multiple oiling.

152 LUBRICATION — Service Dept, Valvoline Oil Co, 547 East 5th St, Cincinnati, Ohio. Pocket-size handbook contains crankcase and grease recommendations for every make and model passenger car made in this country since 1936, for most trucks, tractors, industrial, marine and aviation engines for the same period.

153 LUBRICATION — Lubriplate Div, Fiske Bros Refining Co, Newark, N. J. 16-page illustrated bulletin No. 12-40 covers Lubriplate lubrication. Basic facts on Lubriplate presented, types of lubricant available, and applications of the lubricant. Numerous testimonial letters from purchasers exhibited.

154 LUBRICATION—C A Norgren Co, Denver, Colo. Catalog No. 400 describes all types of Norgren pneumatic products, including complete line of Lubro-Control units for control, cleaning and lubricating air, and Norgren system for oiled-air lubrication of high-speed spindle bearings.

155 LUBRICATION—Wm W Nugent & Co, 412 N Hermitage Ave, Chicago, Ill. Bulletin No. 7A, edition No. 5, describes Nugent pressure-liquid filters for acids, chemicals, oils, water, etc. Construction and operation of filter shown by diagrammatic sketches and photographs.

MAINTENANCE

156 ELECTRICAL SPECIALTIES — Ideal Commutator Dresser Co, Sycamore, Ill. 84-page catalog gives instructions on care of motors and other maintenance equipment with photographs, diagrams and tables. Also illustrates and describes line of company's electrical specialties.

157 BUILDING MAINTENANCE — Flexrock Co, 2377-A Manning St, Philadelphia, Pa. 74-page handbook has technical information for plant managers, maintenance men and superintendents. Shows how to do many odd jobs at lower cost with better results, and presents numerous ideas that save time and money. Non-technically written.

158 IRON CEMENT—Smooth-On Mfg Co, 568 Communipaw Ave, Jersey City, N. J. 40-page application book is revised edition, including methods of repairing leaks, pipe clamps, loose bolts, etc. and many other varied uses in power plant.

159 FUSES AND OILERS—Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee, Wis. Catalog No. 50 tells how to secure maximum fuse protection, how to remove and replace fuses safely, eliminate poor contact between fuses and clips, and how to lubricate all types of bearing surfaces with visible, automatic oiling devices.

160 TESTING MACHINES—Baldwin Southwark Div, Baldwin Locomotive Works, Philadelphia, Pa. 40-page bulletin, illustrated with more than 50 charts and photographs, pictures company's testing machines in capacities from 20,000 to 4,000,000 lb. General specifications and description of operation of standard Southwark-Tate-Emery universal testing machines included. Second section is devoted to accessories such as control apparatus, load maintainers, etc.

161 CEMENTS—Smooth-On Mfg. Co, 570 Communipaw Ave, Jersey City, N. J. Folder shows how to waterproof and patch concrete walls and floors, and how leaks in wells, cellars, etc., can be stopped with Smooth-On cements.

MATERIALS HANDLING

162 MATERIALS HANDLING—Robins Conveying Belt Co, Passaic, N. J. Bulletin No. 114, 16 pages outline company's line of rail clamps for movable structures such as materials-handling bridges, towers, unloaders and cranes. Also contains a cross-sectional diagram of each type as well as photographs of typical installations.

163 CONVEYORS—Jeffrey Mfg Co, Columbus, Ohio, Catalog 758, 8 pages, covers company's line of portable belt conveyors with cross-sectional diagrams and photographs of each type machine described.

164 SCRAPER CONVEYORS—Jeffrey Mfg Co, Columbus, Ohio. 20-page catalog No. 761 depicts portable scraper conveyors, wheel and crawler mounted types for low-cost handling of coal and coke in retail coal yards and industrial plants. Also contains photographs, diagrams and tables of dimensions of conveyors described.

165 SEPARATORS—Stearns Magnetic Mfg Co, Milwaukee, Wis. Bulletin No. 50 offers full details on this particular design separator adapted for use in the purifying of fine powdered material for ceramic and allied processing, also applicable to wet-type magnetic treatment.

166 BUCKET LOADERS—Jeffrey Mfg Co, Columbus, Ohio. 8-page catalog 759 outlines portable bucket loaders for reclaiming coal, coke, sand, crushed stone from ground storage; gives general specifications for each type described as well as actual photographs of these machines in action.

167 MATERIALS HANDLING—R G LeTourneau Inc, Peoria, Ill. 12-page booklet illustrates uses of Tournapull, such as hauling, lifting, loading and dumping, by a series of questions and answers, with photographs and diagrams.

168 HOISTS — American Engineering Co, Aramingo Ave, Philadelphia, Pa. Catalog H-40 describes construction, operation and application of Lo-Hed monorail electric hoists. Comes complete with capacities, speeds, heights of lift and other specifications.

169 MATERIALS HANDLING — R G LeTourneau, Inc, Peoria, Ill. Bulletin entitled, "Solving Coal Storage and Handling Problems with LeTourneau Carryall Scrapers and Bulldozers", explains LeTourneau way of coal handling and contrasts this with other methods. Few of larger plants using company products shown. Form No. G-1045.

170 MATERIALS HANDLING — Robins Conveying Belt Co, Passaic, N. J. 4-page bulletin No. 109 illustrates and briefly describes products made by company. These include belt conveyors, return idlers, bucket elevators, bucket conveyors, vibrating screens, feeders, trippers, conveyor pulleys, weigh larries and gates, among others.

171 WIRE ROPE—Hazard Wire Rope Div, American Chain & Cable Co, Wilkes-Barre, Pa. 24-page booklet gives tables of breaking strengths for all commonly used rope constructions and offers constructive information on effects of acceleration, and suggestions for correcting operating factors affecting safety, such as abrasion, bending fatigue, reverse bends, spooling, kinking, etc.

172 MATERIALS HANDLING—Barrett-Cravens Co, 3255 W 30th St, Chicago, Ill. 100-page junior catalog lists all types of materials-handling equipment made by company. Includes lift and scale trucks, platforms, hoists, portable elevators, cranes, platform trucks, racks and others.

173 CONVEYOR—Link-Belt Co, 307 N Michigan Ave, Chicago, Ill. 24-page book No. 1975 describes completely new Link-Belt product, Bulk-flo conveyor, continuous flow system for loose materials handling. Details of construction and operation explained, while typical conveyor arrangements are pictured.

174 ELEVATOR BUCKETS — Link-Belt Co, 307 N Michigan Ave, Chicago, Ill. Booklet entitled, "Bring Materials Up Right", illustrates, describes and specifies elevator buckets for general service, resistance to abrasion, inclined elevators and for handling clinging and lumpy materials.

175 HOISTS—Wright Mfg Div, American Chain & Cable Co, York, Pa. 100-page catalog lists, describes, and points out advantages of all hoists, trolleys and cranes made by company. Tables of structual steel beams show allowable concentrated moving loads.

176 MATERIALS HANDLING—Syntron Co, Homer City, Pa. 48-page bulletin covers information on vibrators, conveyors, complete feeder machines, packers and jolters, electric hammers, and other vibratory materials-handling equipment with photographs, diagrams and tables.

177 MATERIALS HANDLING — Gifford-Wood Co, Hudson, N. Y. 125-page catalog No. 200 covers all products made by company. These include conveyors, bearings, chains, gates, weigh-larries, sand screens, hoists, etc.

178 TRUCKS—Mercury Mfg Co, 4044 S Halsted St, Chicago, Ill. 4-page illustrated folder illustrates and gives numerous applications of Mercury, tilting tiering trucks. Specifications, features and capacity also given, as are general construction arrangements.

METAL HOSE & TUBING

179 TUBING—Babcock & Wilcox Co, 19 Rector St, New York, N. Y. Data card No. 103A lists seamless tubing wall thicknesses in millimeters and inches, and compares various gages in use today.

METALS & METAL SPRAY

180 METALLURGY — Globe Steel Tubes Co, Milwaukee, Wis. 80-page bound-booklet traces the important steps in conversion of iron ore into finished steel products for non-technical readers interested in the fabrication and application of steels. Also includes chapters on corrosion effect of alloying elements and specifications.

181 HEAVY MACHINERY — Ampco Metal Co Inc, Milwaukee, Wis. 6-page booklet emphasizes the importance of Ampco metal in the field of heavy machinery, where shock, impact and severe wear must be overcome. Diagram shows application in typical road-building equipment.

182 COPPER — Phelps Dodge Copper Products Corp, 8-page bulletin lists advantages, characteristics and applications of PDCP copper. Also includes electrical resistance of copper, with engineering and mechanical properties.

183 BRAZING ALLOYS — Handy & Harman, 82 Fulton St, New York, N. Y. 4-page folder describes "Sil-Fos" and "Easy Flow" brazing alloys. Past applications related, with results obtained.

184 WROUGHT IRON—A M Byers Co, Pittsburgh, Pa. 44-page technical bulletin prepared by engineering service dept of company presents story of radiant heating, in connection with Byers wrought iron. Many installations shown, and theory and advantages of panel heating included.

185 METAL SPRAY—Metallizing Co of America, 562 West Washington Blvd, Chicago, Ill. 52-page bulletin entitled, "The History, Purpose and Practice of Metallizing", contains a brief history of the process, instructions for surface preparation, and picture applications showing uses throughout industry.

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SHAW PREFABRICATED PIPING

No matter how large or intricate your prefabricated piping job is, no matter if it is for high or low pressures, you can depend upon DEPENDABLE, ACCURATE, SAFE work from the Benjamin F. Shaw Company. Forty-nine years specialized experience in this field enables us to offer you skillful, fast, low-cost production. We invite your inquiry.

BENJ.F. SHAW COMPANY
SINCE 1893
WILMINGTON, DEL.

186 STEEL MATS—Wm F Klemp Co, 6651 S. Melvina Ave, Chicago, Ill. 4-page booklet presents advantages of Klemp safety steel mats in industrial plants. Mats can be cleaned, have nonskid grid, and can be rolled like a rug. Other Klemp products illustrated.

187 AMPCO METAL—Ampco Metal, Inc, 1745 S 38th St, Milwaukee, Wis. Card slide selector quickly and easily determines physical properties and chemical composition of all grades of Ampco metal. Reverse of selector contains table listing general uses of alloy by grades.

188 ALLOYS—Ampco Metal, Inc, Milwaukee, Wis. 16-page booklet contains descriptions of alloys, table of alloys, table of physical properties, range of chemical compositions, illustrations of parts and factory scenes.

189 COPPER—Revere Copper & Brass Inc, 230 Park Ave, New York, N. Y. "Copper and Copper Alloys for Power Plants" covers copper and alloy tubing for power plants, including condenser tubes, tube sheets, copper watertube, brass and copper pipe, pole-line hardware, etc.

190 ALLOYS — International Nickel Co, 40 Wall St, New York, N. Y. 12-page catalog gives characteristics, mechanical properties and application information on Inco Nickel Alloys. Also includes tables of physical constants and available forms.

191 CASTINGS—Meehanite Institute, 311 Ross St, Pittsburgh Pa. 49-page booklet entitled "Meehanite in Industry" contains numerous articles about Meehanite castings, covering descriptions of applications in wide variety of industries.

192 ALLOYS—Handy & Harman, New York, N. Y. 16-page bulletin No. 12 describes low-temperature brazing with Sil-Fos and Easy-Flo, brazing alloys, in many fields of production including aviation, automotive, marine, electrical, air-conditioning, refrigeration and many others.

METERS & INSTRUMENTS

(Not Electrical)

193 METERS—Brown Instrument Co, Philadelphia, Pa. 16-page book contains description of operating principle and special features of company's flow and liquid-level meters. Schematic diagrams show special applications of meters and general mounting dimensions.

194 INSTRUMENTS—C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y. 26-page Catalog No. 1210 lists all the latest TAG recorder developments including new line of recording thermometers, pressure gages with 9-, 10, and 12-inch charts. Many illustrations show how these pressure-spring instruments operate.

195 FLUID METERS—Fluid Meters Inc, 60 Wall Tower, New York, N. Y. 4-page folder, entitled "Exact Fuel Metering by Positive Displacement for Extra Diesel Profit" explains a new check to maintain acceptance-test fuel economy.

196 FLOW METERS—Ring Balance Instrument Co, 740 N Franklin St, Chicago, Ill. 12-page Bulletin No. 41 covers company's line of flowmeters for all fluids, including steam, water, brine, oil, gas and air; discusses operating principles and specifications of standard models.

197 INSTRUMENTS — Permutit Co, 330 West 42nd St, New York, N. Y. 20-page Bulletin R 40 features Ranarex instruments for measuring CO_2 in flue gases, specific gravity of gases, quality of furnace atmospheres, engine exhaust composition and special uses. Also shows some typical charts, scales and instruments.

198 SCALES—John Chatillon & Sons, 85 Cliff Street, New York, N. Y. Catalogue No. 27, 44 pages, presents descriptions of weighing apparatus in general use, such as crane scales, dynamometers, thermoseal counter platform scales, spring-testing machines and many others. Gives order number, capacity, length and weight in most cases as well as prices applying.

199 INSTRUMENTS — Westinghouse Elec & Mfg Co, Dept 7-N-20, East Pittsburgh, Pa. 12-page bulletin, catalog section 43-330, describes miniature ac and dc voltmeters and ammeters in the 2-in. classification for general use. Typical instruments are illustrated and cutaway views show construction details. Also lists ratings, scale divisions, style numbers and list prices.

200 CHART BOOK—C J Tagliabue Mfg Co, Park and Nostrand Aves, Brooklyn, N. Y. 32-page chart book illustrates mercury and gas-filled ranges and charts, electric clocks, spring-wound clocks, recorder charts, chart files, instrument locks, recorder ink, and miniature size charts.

201 WATER GAGES—Paul B Huyette Co, Inc, 205 E 42nd St, New York, N. Y. 4-page bulletin 741 presents water gauges in "PBH" vertical, tiltview and round-flange marine types with illustrations and descriptions of each type. Contains descriptions and illustrations of "PBH" water gauge specialties.

202 THERMOMETERS — Brown Instrument Co, Philadelphia, Pa. 24-page catalog No. 6706-A supplements other Brown catalogs, listing and describing bulbs, sockets, tubing and accessories for company's complete line showing tubing extension necks, separable sockets, wrought iron sockets and fittings, wet and dry-bulb assemblies, etc. Also contains sections on application, arrangement and other practical data.

203 WATER COLUMNS—Ernst Water Column & Gage Co, Livingston, N. J. 28-page catalog presents a wide range of water columns and gages with other related boiler accessories, with many photographs, diagrams, and prices applying.

204 DRAFT GAGES—The Hays Corp., Michigan City, Ind. 20-page booklet entitled "Draft—What, Where, How, Why," by W H Pugsley, manager of engineering, The Hays Corp, tells story of draft, what it is, how it is measured, what draft gages tell, and selecting draft gage to suit requirements. Part II covers where to measure draft and pressure in a modern plant, while part III tells where to connect draft gages on various types of fuel feed. Conclusion consists of instructions, with diagrams, on how to install draft gages.

205 SMOKE INDICATORS — Brooke Engineering Co, 4517 Wayne Ave, Philadelphia, Pa. 4-page folder describes operation and parts of photoelectric smoke-density indicator and recorder. Line drawings show dimensions of important parts.

206 TACHOMETERS—Boulin Instrument Co, New York, N. Y. 4-page folder lists purposes, specifications and prices of company's centrifugal tachometers with photographs of instruments described.

207 PYROMETERS—Leeds & Northrup Co, Stenton Ave, Philadelphia, Pa. Catalog E-33A-503 describes apparatus for checking thermocouple pyrometers in plant and laboratory. Lists everything needed to check pyrometers, with recommendations.

208 COMBUSTION INDICATOR — Boiler Room Equipment, Inc, 45 W 45th St, New York, N. Y. 6-page folder presents "Sentry" smoke alarms and recorders, giving operation, advantages, and causes of excess smoke.

209 PHOTOMETER—Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia, Pa. 20-page catalog E-72 describes entire line of photometers, used for testing lamps, making lighting surveys, photometric research and in laboratories.

210 FLOWMETERS—Cochrane Corp, Philadelphia, Pa. 52-page handbook shows complete line of flow-measuring instruments, including electric flow meters, electric linameters, mechanical flow meters, liquid-level meters, etc. Also gives applications to steam, air, water, gas, and viscous, volatile, and corrosive-fluid measurement.

211 CONTROLS — Wheelco Instruments Co, 1929-33 S Halsted St, Chicago, Ill. 12-page Bulletin No. Z4000 is convenient condensed listing of principal items of equipment made by company. Includes Capacitrols, Flame-otrols, pressure indicators and controllers, thermocouples, switches and others.

212 MEGOHMER—Herman H Sticht Co, 27 Park Pl, New York, N. Y. Bulletin No. 430 describes new Model B-5 Megohmer. Covers detailed explanation of instrument, ease of operation, ease of maintenance, and applications in the field.

213 REGULATOR — Northern Equipment Co, Erie, Pa. 8-page bulletin presents report on operating experience at Jacob Ruppert Brewery with Copes Flowmatic Regulator. Diagrams show process hookup, method of installing regulator and instrument itself, with direct-operated valve.

214 PNEUMATIC TRANSMISSION—Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa. 24-page bulletin No. 9400 covers Brown pneumatic-transmission indicating and recording equipment, showing typical diagrammatic applications and pointing out advantages.

215 FLOWMETER — American District Steam Co, North Tonawanda, N. Y. 4-page, 2-color folder No. 140 concerns ADSCO flowmeter of orifice type for metering of steam, water, air or gas. Illustrates and describes construction.

216 THERMOMETERS — Manning, Maxwell & Moore, Inc, Bridgeport, Conn., 1941 edition of industrial thermometer catalog brought up to date with additions to American thermometer line.

217 PYROMETERS — Brown Instrument Co, Philadelphia, Pa. 24-page catalog covers Brown pyrometers, millivoltmeter type, and is illustrated with photographs of units. Construction features and operating advantages also described. Catalog also covers photographs and descriptions of diesel-engine pyrometers, marine-type and portable pyrometers.

218 LIQUID-LEVEL GAGES—Bristol Co, Waterbury, Conn. Catalog 1015 describes float, pressure-bulb, pressure, air-bubbler, counterpoise and differential pressure-type water- and liquid-level gages for all applications. Also covers measurement and automatic control of liquids in open and closed vessels where surface of liquid is under static pressure.

219 PYROMETERS — C J Tagliabue Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y. Catalog No. 1101F describes all latest improvements made in "Celectray" photoelectric-action pyrometers during past year. Photographs show typical installations.

MOTORS

220 MOTOR-GENERATORS — Motor Generator Corp, Box MG-1, Troy, Ohio. 4-page pamphlet presents new line of motor generators for electroplating, anodizing and special applications.

221 MOTORS — General Electric Co, Schenectady, N. Y. Publication GEA-3580 presents highlights on design, construction and application of Tri-Clad motors. Photos show construction of different parts. Other photos show many types of tri-clad motor and typical industrial applications.

222 MOTORS — Allis-Chalmers Mfg. Co, Milwaukee, Wis. 28-page bulletin B-6107 covers all types of motors suitable for power plant applications of 1 hp and larger. Illustrates and describes more important ones.

223 MOTOR CONTROL — Cutler-Hammer, Inc, Milwaukee, Wis. 36-page booklet describes Unitrol, method of grouping motor controls efficiently and compactly. Catalog explains what Unitrol is, what it is used for, various arrangements available, and ease of installation. Samples specification for Unitrol sectionalized control center presented.

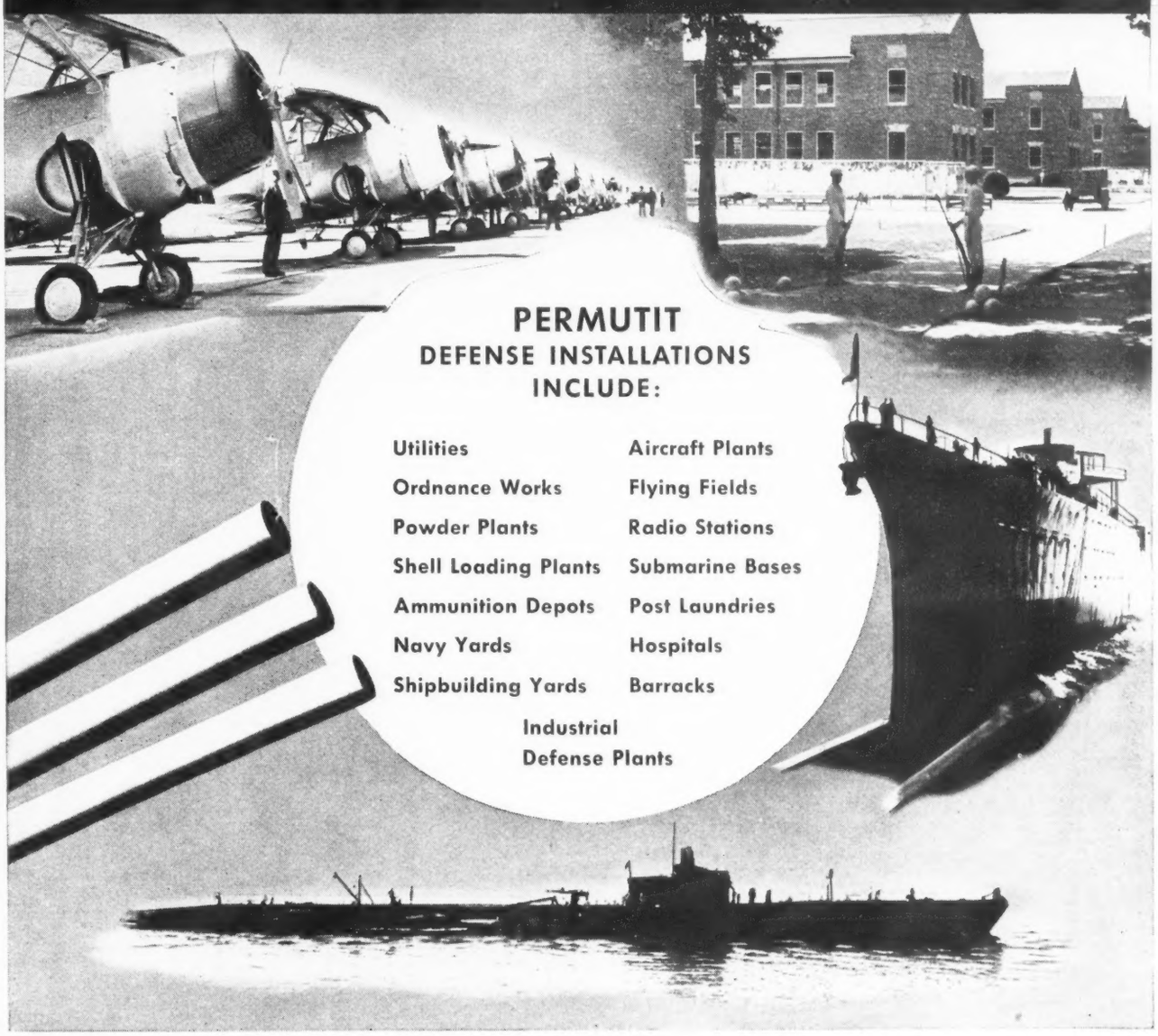
224 MOTORS — General Electric Co, Schenectady, N. Y. GEA-3488, entitled, "How to Maintain DC Motors", covers selection, inspection and maintenance of dc motors, designed to make motors give better service longer. Trouble-correction chart gives cause, symptom and remedy for numerous motor troubles. Suggested inspection schedule presented, as well as hints on replacing worn motor parts.

225 MOTORS—Century Electric Co, St. Louis, Mo. 4-page bulletin No. A120 describes totally enclosed fan-cooled squirrel-cage induction motors, for installation where surrounding atmosphere is charged with damaging quantities of metallic, abrasive, or other dusts, cutting or coolant solutions, acid or alkali fumes.

226 MOTORS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 8-page bulletin, No. B6052-B describes the line of company's Lo-Maintenance motors in ratings from ¾ to 75 hp, open, enclosed and splash-proof types, ac and dc.

227 MOTOR STARTER—General Electric Co, Schenectady, N. Y. 6-page folder GEA-2964A covers size 1 magnetic motor starters. Features not ordinarily seen on first glance shown by photographs, and section included shows how movable contacts are removed and replaced.

Water conditioning by PERMUTIT* . . . a defense necessity, too!



Permutit feedwater treatment keeps boilers operating without shutdown . . . prevents losses not only in boiler time, but in generator or prime mover output. Today more than ever—under the strain of increased production—power plants rely upon Permutit for continuous operation at maximum efficiency.

Permutit makes every type of water conditioning equipment . . . prescribes treatment that exactly fits individual plant needs.

• • •

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PERMUTIT WATER CONDITIONING HEADQUARTERS

228 MOTOR—Howell Electric Motors Co, Howell, Mich. Bulletin RS-60 describes protected open-type motors, showing parts construction and materials used in motor building. Shows tests motor parts have to pass before being assembled and sold.

229 MOTORS — General Electric Co, Schenectady, N. Y. 4-page folder GEA-1542-D describes heavy-duty dc motors, giving construction features and enclosures available.

230 MOTORS — Allis-Chalmers Mfg Co, Milwaukee, Wis. Leaflet B6131 illustrates and describes Lo-maintenance Type E dc motors and generators for ratings up to 200 hp and 40 kw.

PAINTS & COATINGS

231 SPRAY PAINTING—Binks Mfg Co, 3114 Carroll Ave, Chicago, Ill. 92-page loose-leaf catalog gives complete engineering data and specifications, together with prices on spray booths, spray guns, oil and water extractors, air supply and exhaust systems, portable painting outfits and automatic finishing equipment.

232 PAINT REMOVER—Presto Products Co, 4709 Columbia Ave, Dallas, Texas. 4-page folder lists grades, advantages and applications of Presto paint remover.

PIPING AND FITTINGS

233 STEAM TRAPS—W H Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa. 20-page Catalog No. 941 describes four types of traps, industrial steam, expansion steam, weight operated and piston operated, with many diagrams, drawings, tables and photographs. Also lists many representative users.

234 PIPE COVERING—Baldwin-Hill Co, Trenton, N. J., 4-page folder describes pipe covering, effective up to 1000 F, adaptable for long runs of steam lines, either overhead or underground. Also contains chart of thermal conductivity.

235 EXPANSION JOINTS — Yarnall-Waring Co, Philadelphia, Pa. 32-page bulletin EJ-1908, discusses Gun-Pakt expansion joints, their construction, dimensions, prices, shipping weights, and portrays typical installations. Also explains how to figure size and expansion of and anchors for pipe lines.

236 STEAM TRAPS—W H Nicholson & Co, 12 Oregon St, Wilkes-Barre, Pa. 8-page bulletin No. 439 with supplement, bulletin No. 1041, lists five types of industrial steam traps, their size range, outstanding features, operation, capacity factors, recommended piping diagrams, typical applications and representative users.

237 PIPE COUPLINGS—Dillon Co, 220 C East Brady St, Tulsa, Oklahoma. 4-page leaflet describes and illustrates Dillon couplings, for oil, gas, water or air, vacuum or pressure. Applications shown by photographs.

238 TRAPS — Armstrong Machine Works, Three Rivers, Mich. 4-page bulletin describes Armstrong line of air traps and presents useful engineering data on removal of water from compressed air.

239 PIPE UNITS—Ric-Wil Co, Cleveland, Ohio. Catalog No. 41 contains complete data on all approved types of construction on underground conduit systems for steam and hot-water lines, with special emphasis on Ric-Wil presealed insulated pipe units.

240 PIPE FITTINGS—Taylor Forge & Pipe Works, Chicago, Ill. 216-page catalog No. 401 has complete data on design, pressure and temperature ratings of seamless steel pipe fittings for welding. Also gives data on flange bolting, new test analyses, accepted standards, etc., of forged steel flanges.

241 PIPING — American Locomotive Co, Alco Products Div, 30 Church St, New York, N. Y. 4-page bulletin tells advantages and facilities of company and company products. Various examples of pre-fabricated piping shown.

242 BOILER-RETURN TRAPS — Johnson Corp, Three Rivers, Mich. 8-page Bulletin E describes services of Johnson "Electrap," including method of operation, boiler-feed service, lifting service, vacuum service, and dimensions.

243 CONDUIT SYSTEMS—H W Porter & Co, Newark, N. J. illustrates monolithic "sidewalk" base, internal channel drain, arch and tile construction, provision for various types of insulation, adaptability and accessibility of Therm-O-Tile underground steam conduits, to take care of all pipe sizes and any number of pipes.

244 EXPANSION JOINTS — United States Rubber Co, Rockefeller Center, New York, N. Y. 28-page catalog describes U. S. Rubber expansion joint, with results of test comparing a rubber joint with a metal one. Typical pipe layouts included, and data on linear expansion of pipe and recommendations presented.

245 TRAP—W H Nicholson Co, 12 Oregon St, Wilkes-Barre, Pa. Single-page bulletin shows Nicholson weight-operated trap in cross-section, illustrating different parts and giving applications.

246 PIPE HANGERS — Power Piping Div, Blaw Knox Co, 1525 Pennsylvania Ave, Pittsburgh, Pa. 12-page bulletin No. 1815 covers functional hangers and vibration eliminators. Tells where to use each, shows several actual installations, and foldout insert pictures a typical layout of 3-plane piping structure supported by hangers and eliminators. Types and characteristics of each presented.

247 SHAFT SEALS—Fulton Sylphon Co, Knoxville, Tenn. 16-page illustrated catalog covers Sylphon shaft seals, used to prevent leakage of a liquid or gas around a rotating shaft. Both stationary and rotating type seals are described and illustrated.

248 VACUUM TRAP—K & M Heating Specialties Co, Empire State Bldg, New York, N. Y. Leaflet describes K & M self-venting vacuum trap for relieving congestion in steam systems by proper venting. Line drawing illustrates important trap parts.

249 HOSE—Hewitt Rubber Corp, Buffalo, N. Y. 34-page booklet illustrates and describes hose for use in industry. Includes section on packing, couplings, and provides engineering tables showing pipe sizes, materials affecting rubber, and properties of saturated steam.

250 SERVICE CLAMPS—Band-it Co, 2536 Walnut St, Denver, Colo. 4-page folder describes numerous uses of Band-it clamp, for repairing all sizes and types of hose, pipe, tanks, etc. Photographs show how to apply clamp correctly.

PUMPS

251 PUMPS—Pomona Pump Co, 120 Broadway, New York, N. Y. 24-page bulletin No. 29-A107 features company's line of pumps for diversified industrial application giving photographs of actual installations and cross-sectional diagrams showing the pumping principles that apply to the particular installations illustrated.

252 PUMPS — Kimball-Krogh Pump Co, Div of Food Machinery Corp, 301 West Avenue 26, Los Angeles, Calif. Bulletin No. 120-A outlines Kimballectric horizontal centrifugal pumps in a wide range of applications. Many photographs, and cross-sectional diagrams point out the compact design which permits installation in small quarters.

253 PUMPS—Pennsylvania Pump & Compressor Co, Easton, Pa. 8-page bulletin No. 237 describes Thrustfre multi-stage centrifugal pumps as furnished in 2-, and 3-stage types, for direct- or belt-drive. Also contains cross-sectional diagrams and photographs of typical pumps.

254 CHEMICAL PUMPS—Milton Roy Pumps, 1305 E Mermaid Ave, Philadelphia, Pa. 16-page catalog No. 941, illustrates, describes and gives specifications of company's line of pumps for handling chemicals in precisely-controlled quantities. Also lists typical chemicals handled, industries served, features of design and materials of construction.

255 CENTRIFUGAL PUMP—De Laval Steam Turbine Co, Trenton, N. J. 4-page paper is reprint from POWER of article, "Adjusting Centrifugal-Pump Speed Cuts Operating Costs," and is divided into two parts. First has to do with insertion of variable-speed coupling beween motor and pumps, while other deals with insertion of coupling beween several pumps in unit.

256 PUMPS—Deming Co, Salem, Ohio. 192-page Catalog No. 33 features typical installations of many pump types, including reciprocating, centrifugal, rotary and special-service power pumps. Also includes tables of information such as weights and measures, comparative equivalents of liquid measures and weights, etc.

257 PUMPS—Fairbanks, Morse & Co, Chicago, Ill. 4-page bulletin, 6720X, describes horizontal short-coupled motor-driven pumps with photographs of actual installations; presents diagrams and tables giving principal dimensions, sizes and ratings.

258 PUMPS — Pacific Pump Works, Huntington Park, Calif. Bulletin No. 78 describes Pacific single-stage process centrifugal pumps, Type "SV". In addition to complete description, booklet has pictures showing component part assemblies, as well as installation views.

259 PUMPS — Gould Pumps, Inc, Seneca Falls, N. Y. 140-page industrial catalog in sectional form contains bulletins on all various types of pumps, including centrifugal, reciprocating and rotary pumps, sump pumps, condensate-return units and many miscellaneous units.

260 PUMPS—Allis-Chalmers Mfg Co, Milwaukee, Wis. 40-page bulletin No. B-6146 describes and illustrates single-stage double-suction centrifugal pumps. Besides construction features, dimensions and application data, bulletin includes friction tables, head-capacity tables and other pump information.

261 PUMPS—Allis-Chalmers Mfg Co, Milwaukee, Wis. Bulletin B-6140 covers "Electrifugal" pumps for 1 to 10 hp inclusive for heads up to 160 ft. Illustrates and describes construction, using various motors as driving media.

262 PUMPS—Pennsylvania Pump and Compressor Co, Easton, Pa. Bulletin 194, 16 pages, outlines with photographs and diagrams heavy-duty, horizontal, single-stage compressors.

263 PUMPS—Warren Steam Pump Co, Warren, Mass. Two 6-page bulletins 228-1 and 229-1 on 2-stage volute centrifugal pumps, include specifications, sectional views, ratings tables, dimensions, etc.

264 PUMPS — Worthington Pump & Machinery Corp, Harrison, N. J. Bulletin, W-412-B30 describes and illustrates horizontal duplex-plunger power pumps, types KLF, KKF and KMF. Drawings and photos show system of lubrication, bearings, pistons, etc.

265 SCREW PUMPS—Quimby Pump Co, 340 Thomas St, Newark, N. J. 8-page bulletin No. S-203 describes and illustrates screw pumps made by company in three types: gear-in-head, external gear, and hopper. Test results of one pump included and photographs of several typical installations presented.

266 CENTRIFUGAL PUMPS—Allis-Chalmers Mfg Co, Milwaukee, Wis. 8-page book describes and illustrates wide range of centrifugal pumps; gives applications, features, construction, sizes and capacities.

267 PUMPS—Nash Engrg Co, South Norwalk, Conn. 8-page bulletin No. 336 gives construction details, capacity curves, and illustrations of Nash glass pump, a centrifugal of "Pyrex" brand, heat-, shock-, and acid-resistance glass. Approximate dimensions and pipe sizes included.

268 PUMPS—Lawrence Machine & Pump Corp, 371 Market St, Lawrence, Mass. Bulletin 207-2 describes surry and sludge pumps, adapted for handling slurries containing solids in suspension, with wide application in chemical plants, and industrial plants.

269 CENTRIFUGAL PUMPS—Worthington Pump and Machinery Corp, Harrison, N. J. 4-page booklet explains specifications of company's 2-stage centrifugal pumps with cross-sectional diagrams.

270 PUMPS — Pacific Pump Works, Huntington Park, Calif. 12-page booklet shows company's single-stage centrifugal pumps designed for process service, with photographs, cross-sectional and dimensional diagrams.

271 PUMPS—J S Coffin, Jr. Co, Englewood, N. J. Bulletin I-21 describes the Coffin centrifugal pump for industrial, marine and railroad use, in boiler-feed and general-pressure service. Each part, such as impeller, casing, governor, etc, described separately, and large cross-sectional drawing shows pump construction.

272 PUMPS—Worthington Pump & Machinery Corp, Harrison, N. J. Bulletin No. W-325-B1 covers single-stage condensate pumps, Type JZ for hotwell, condensate, chilled water and general service. Mechanical features and hydraulic design presented.

273 PUMPS—Allis-Chalmers Mfg Co, Milwaukee, Wis. 4-page Bulletin No. B6153 gives over-all dimensions, ap

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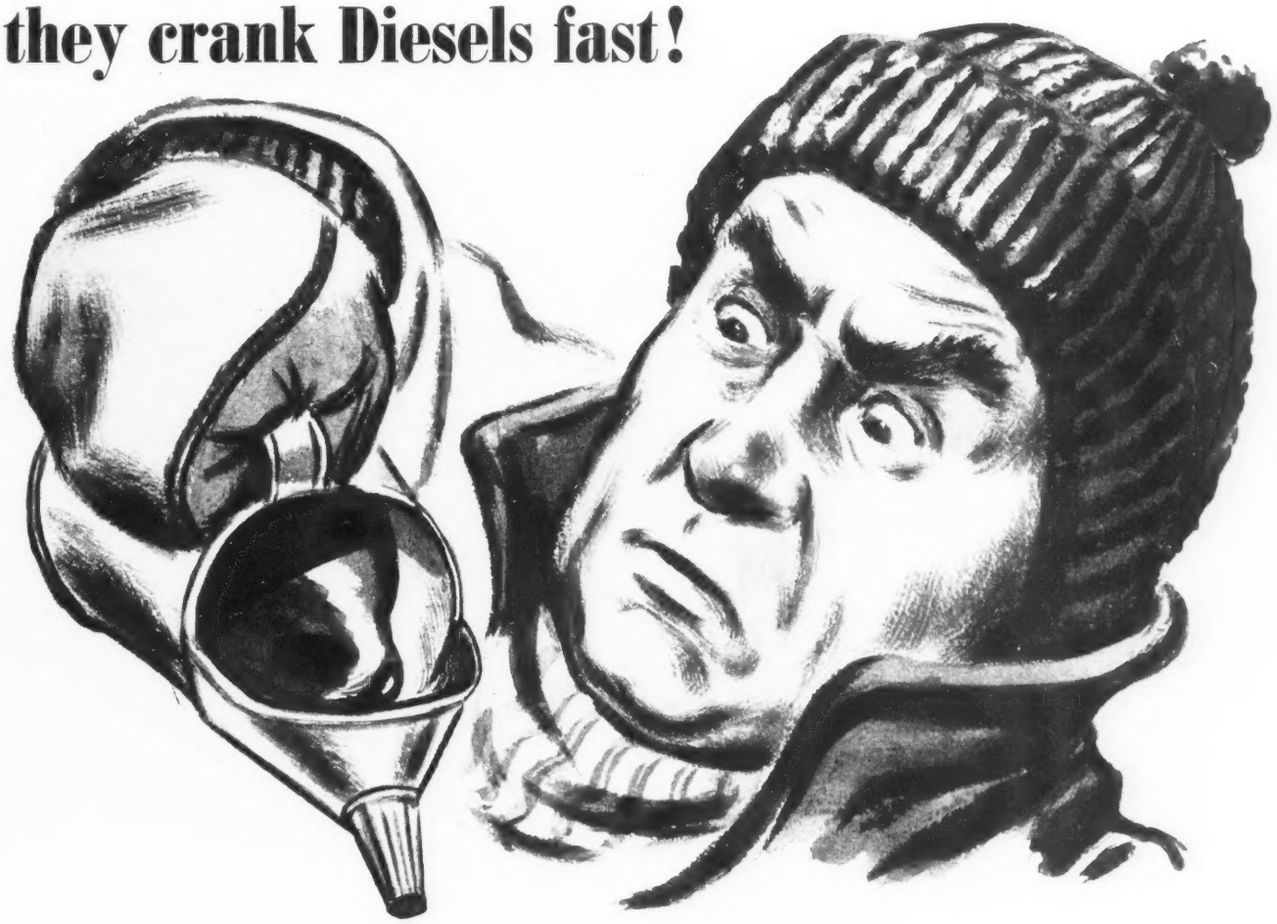

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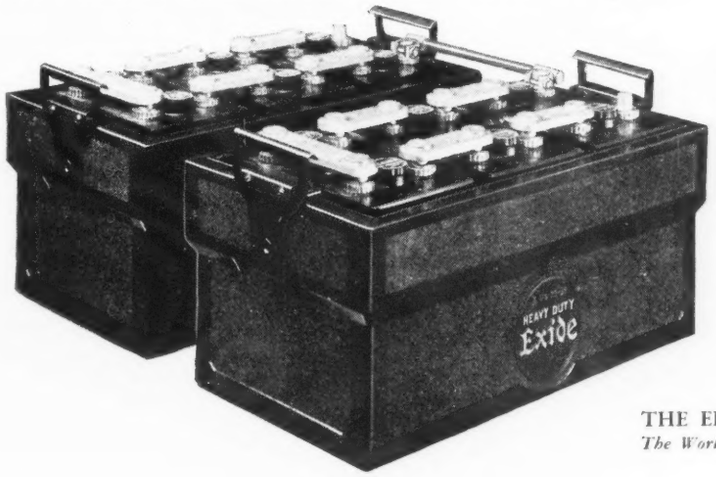

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plications and selection table for engine-driven centrifugal pumps.

274 PUMPS — Warren Steam Pump Co, Warren Mass. 4-page bulletin includes specifications, sectional views, dimensions, ratings of steam pumps, and capacity tables.

275 PUMPS—Worthington Pump & Machinery Corp, Harrison, N. J. Bulletin W-350-B7 describes centrifugal process pumps, Types CV, CVX, and CW, for chemical and allied industries.

REFRACTORIES

276 REFRACTORIES — Atlas Lumnite Cement Co, Chrysler Bldg, New York, N. Y. 14-page bulletin gives detailed information on mixing and placing Lumnite, cold-setting, monolithic refractory material for industrial furnace construction. Six charts give hot- and cold-face temperature and heat loss for different thicknesses of several types of furnace walls at operating temperatures from 250 to 2500 F.

277 FIREBRICK — Armstrong Cork Co, Lancaster, Pa. 8-page booklet describes Armstrong insulating firebrick, five types for temperatures to 2600 F. Paragraphs cover each type of brick.

278 FIREBRICK — Botfield Refractories Co, Swanson & Clymer Sts, Philadelphia, Pa. 4-page folder gives numerous applications for Adamant firebrick cement, presents instructions for using same, and includes testimonials by satisfied users.

279 FIRE BRICK—A P Green Fire Brick Co, Mexico, Mo. "Modern Fire Brick Manufacture" is illustrated book which shows with dramatic photographs story of production of fire brick as carried on in company plant.

280 REFRACTORY — Harbison-Walker Refractories Co, Pittsburgh, Pa., 6-page folder reports mineral constitution, chemical composition, strength, spalling resistance and other features of Korundal, as well as chart which shows melting point of alumina-silica refractories.

281 REFRACTORY — Johns-Manville, New York, N. Y. 4-page folder describes Firecrete, refractory for furnace covers and bottoms, door linings and other monolithic refractory construction.

282 REFRACTORY—Refractory & Insulation Corp, 381 Fourth Ave, New York, N. Y. 2-page leaflet describes "Chromio," plastic-chrome ramming refractory. Advantages and working qualities of refractory given, and extensive applications listed.

283 REFRACTORY — Plibrico Jointless Firebrick Co, 1800 Kingsbury St, Chicago, Ill. 4-page booklet describes Plicast L-W-I, a light-weight insulating castable refractory, for industrial furnaces, oil and gas burners, boiler applications, etc, with many diagrams illustrating its features.

SPEED REDUCERS

284 SPEED REDUCERS—Winfield H Smith, Inc, Springville, Erie County, N. Y. 36-page catalog covers single-worm gear reducers, double-worm gear reducers, helical-gear reducers, helical and worm-gear reducers, spur-gear reducers, 2-speed and differential reducers, covering range from fractional to 100 hp, ratios from 2-1 to 20,000-1.

STOKERS

285 STOKERS—Flynn and Emrich Co, Baltimore, Md. 16-page catalog 1204, describes underfeed stokers, designed and developed for heavy-duty industrial boilers in both single- and double-retort type with stationary or moving grates and either electro-hydraulic or steam drive.

286 STOKER—American Coal Burner Co, 155 East Superior St, Chicago, Ill. 8-page folder illustrates, points out advantages of and describes "Fyr-Feeder" stoker. Line drawings show essential parts, and principle of operation explained.

287 STOKERS—Canton Stoker Co, Andrew Place, Canton, Ohio. Illustrated catalog describes Canton Lo-Set Ram Feed Stokers, used for smaller installations where space is limited. Typical installations pictured.

288 STOKER—Combustion Engineering Co, 200 Madison Ave, New York, N. Y. Catalog No. 88-2 describes latest design features of C-E spreader stoker, including photographic illustrations of assemblies and typical installations and closeup views of feeder, distributor, drive mechanism and dump-gate details.

289 STOKER—Iron Fireman Mfg Co, 3015 West 106 St, Cleveland, Ohio. Novel bulletin gives visual presentation of Iron Fireman spreader stoker, and includes in text matter: the company behind the product; the pneumatic spreader principle; feeding and conveying the coal; combustion in the furnace; and other brief articles.

SWITCHES & CIRCUIT BREAKERS

290 TRANSFORMERS—Sola Electric Co, 2525 Clybourn Ave, Chicago, Ill. 24-page bulletin No. CV-74 describes Sola constant-voltage transformers for many uses including industrial power, fluorescent lights, oil-burner ignition, luminous tube signs, mercury lamps, signals and controls, etc. Many charts, graphs, diagrams and photographs are included.

291 TRANSFORMERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 20-page bulletin, B6171, describes core and coil construction of circular-coil, shell-type high-voltage power transformers. Also features cut-away section through a typical transformer, showing details of construction.

292 SWITCHGEAR — Allis-Chalmers Mfg Co, Milwaukee, Wis. Bulletin B-6012A covers metalclad, vertical-lift switchgear. Covers special construction features and advantages of company line; includes installation views, dimensions, outline drawings and circuit diagrams.

293 CONNECTORS — Burndy Engrg Co, 459 East 133rd St, New York, N. Y. 64-page data book describes complete line of solderless electrical connections for cable, flat-bar and tubular conductors and gives technical data on insulated cable and flat copper bars. Included are tables of sizes, dimensions, weights and prices of each design of terminal.

294 SWITCHGEAR—General Electric Co, Schenectady, N. Y. GEA-2499A gives most important facts about G-E master metal-clad switchgear, telling how to remove breakers, how mechanical interlock works and how other parts operate.

295 AIR CIRCUIT BREAKERS — Westinghouse Electric & Mfg Co, East Pittsburgh, Pa. 11-page leaflet describes compressed-air circuit breakers up to 34.5-kv, 1,500,000-kva interrupting capacity for indoor use. Distinctive features, construction and operation discussed in detail.

296 SWITCHES—Schweitzer & Conrad, Inc, 4435 Ravenswood Ave, Chicago, Ill. Bulletin 210 describes disconnect switches for distribution systems. Types ES, ESL switches covered, with illustrations used to present construction features.

297 ELECTRICAL CONNECTORS—Burndy Engrg Co, Inc, 459 East 133rd St, New York, N. Y. 64-page data book No. 41 describes complete line of solderless electrical connectors for cable, flat-bar and tubular conductors and gives technical data on insulated cable and flat copper bars.

298 CIRCUIT BREAKER—I T E Circuit Co, Philadelphia, Pa. Single-page leaflet describes and illustrates Type K A air circuit breaker. Advantages and features presented.

299 TRANSFORMERS — Allis-Chalmers Mfg Co, Milwaukee, Wis. 16-page bulletin No. B-6084 covers assembly and installation of A-C power transformers. Booklet is filled with installation views; short items explaining each included.

TOOLS

300 SAFETY TOOLS—Ampco Metal, Inc, 1745 South 38th St, Milwaukee, Wis. 8-page folder describes complete line of Ampco non-sparking safety tools, illustrating each.

301 HYDRAULIC EQUIPMENT — Blackhawk Mfg Co, Milwaukee, Wis. Catalog No. 41H describes and illustrates complete line of hydraulic equipment, including jacks, pipe-benders, etc.

302 TOOLS—Bonney Forge & Tool Works, Allentown, Pa. Catalog No. 41, 104 pages, describes complete line of tools with illustrations of tools ranging from special cabinets and tool sets to screw drivers and pliers.

303 JACKS—Buda Co, Harvey, Ill. 32-page bulletin, No. 1019 illustrates models and sizes for all lifting jobs and offers information on how to select correct jack to use. Also lists prices for each type.

VALVES

304 RELIEF VALVES—Foster Engrg Co, 109 Monroe St, Newark, N. J. Catalog 70 Bulletin 23, 8-page booklet, describes relief valve and duplex back-pressure valve and vacuum breaker operation, installation, dismantling and reassembling. Also gives list of parts for valves described as well as spring ranges for average conditions.

305 BLOWOFF VALVES — Yarnall-Waring Co, Philadelphia, Pa. 24-page bulletin B-421 features blowoff valves for low and medium pressure boilers. Many tables outline construction details, physical and chemical properties of metals in Yarway valves, prices and weights of complete valves, prices of parts, dimensions. Also lists typical installations and representative users.

306 VALVES—Ashton Valve Co, Cambridge, Mass. 32-page book outlines industrial pop and safety valves, construction details, capacities, saturated steam temperatures, with photographs, diagrams and tables. Also gives instructions for their application, care and maintenance.

307 VALVES—Henry Vogt Machine Co, Louisville, Ky. 27-page Catalog F-8 includes general information, material specifications, pressure-temperature service ratings on screw-end gate valves, screw-end globe valves, screw-end angle valves, and screw-end check and angle-check valves. Also covers strainers, chainwheels, gage cocks, reflex and transparent gages, and flanged gate, globe, check and slide valves, etc.

308 VALVES—Golden-Anderson Valve Specialty Co, Pittsburgh, Pa. 96-page spiral-bound catalog presents some of company's various types of automatic control valves, designed for steam and water service. Operating sequence, construction, cushioning and arrangement of types listed.

309 VALVES—Reed Roller Bit Co, Reed Valve Div, Houston, Texas. 80-page catalog lists Reed valve materials and all valves made by company, including those for stationary and marine service. Miscellaneous tool materials also covered. Includes extensive engineering data section, with data sheets on resistance of valves and fittings to fluid flow, discharge of water through smooth pipes, spacing of pipe supports, weight of air at various pressures, many conversion charts and tables, and practical hydraulic data.

310 VALVES — American Chain & Cable Co, 929 Connecticut Ave, Bridgeport, Conn. Wire-bound catalog contains all pertinent information regarding cast-steel valves and fittings. Standard symbols and valve markings included, and typical chemical compositions and physical properties of valves given.

311 VALVES—Reading-Pratt & Cady Div, American Chain & Cable Co, Inc, Reading, Pa. Folder covers improvements in valve line designed to meet wide variety of service. Three types of seating and seating materials, range of temperature also described.

312 VALVES—B F Goodrich Co, 460 S Main St, Akron, Ohio. 2-page folder describes Goodrich Vulcalock rubber-lined valves for handling corrosive and abrasive fluids at fairly high pressures. Integral parts explained, and specific directions on use listed.

313 VALVES—R S Products Corp, Wayne Junction, Philadelphia, Pa. 12-page bulletin No. 8-B features late models and wafter-type butterfly or blast-gate valves for control of air, gas, steam and liquids. Contains data and illustrations for both manual and automatic control by means of air and electric motors, solenoids, air and hydraulic cylinders.

314 VALVES—D H Skeen & Co, 1 No. LaSalle St, Chicago, Ill. 4-page leaflet covers Phillips valve, for gas, liquids, flowing solids, etc. Principle of closure explained and numerous photos show applications with condensing water, pulverized coal, and others.

315 RADIATOR VENT VALVE—F J Raymond Co, 629 W Washington Blvd, Chicago, Ill. 4-page folder describes Raymond Dri-Vent radiator vent

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valve, giving theory, construction, operation and operating advantages.

316 VALVES—Homestead Valve Mfg Co, Coraopolis, Pa. 4-page bulletin covers Homestead valves in various types, and their application to ships and industry, stressing their use in national defense.

317 VALVES—Brown Instrument Co, Philadelphia, Pa. Catalog 71-1 describes line of motor power units and motorized valves designed to operate with Brown instruments. Photographs shown of electric control motors, slip-stem globe type, rotary-stem globe type, butterfly-type, pilot-operated, 3-way and special valves.

318 VALVE CONTROLS — Philadelphia Gear Works, Erie Ave & G St, Philadelphia, Pa. 4-page folder describes in detail "Limitorque" valve controls, operating doors, damper controls, gate, globe, butterfly, and plug valves. Field of service of control presented.

319 VALVES—Jenkins Bros, 80 White St, New York, N. Y. "Where to Use Valves, Drains and Bypasses" is booklet containing helpful information on construction and selection of all types of valves, as well as proper application of drains and bypasses. Includes list of all Jenkins Valves meeting ASME Power Boiler Code, and paragraphs from this code relating to valves.

320 VALVES—Hancock Valve Div, Manning, Maxwell & Moore, Inc, Bridgeport, Conn. 8-page bulletin features Hancock Superfinished "500 Brinell" Bronze Valves. Describes application of superfinish operation to manufacture of bronze valves, and covers recently developed Hancodur stems and bonnets used in new valves.

321 VALVES — Defender Automatic Regulator Co, 308 S 8th St, St. Louis, Mo. 4-page folder illustrates and describes adjustable and self-regrinding chronometer valves. Typical applications shown by photos and drawings.

322 VALVE DISKS—Jenkins Bros, 80 White St, New York, N. Y. Bulletin 190, entitled, "Guide to Correct Disk Service", contains complete data on valve disks, showing different types, sizes and compounds available. Disk recommendations listed for each type.

323 VALVE RESEATERS — Leavitt Machine Co, Orange, Mass. 4-page folder entitled "Preventive Maintenance" shows different types of Dexter valve reseaters and how machines are set up on valve.

WATER TREATMENT

324 WATER TREATMENT — Water Treatment Co of America, 1161 Hodgkiss St, Pittsburgh, Pa. Baerite bulletin No. 15, 8 pages, explains Baerite formula for raw-water treatment in boilers for industrial plants, railroads and steamships.

325 DEAERATORS—Cochrane Corp, Philadelphia, Pa. 36-page booklet offers a comprehensive treatment of tray-type deaerators, atomizing deaerators, deaerating hot-water generators. Also includes section on flow diagrams including photographs of units described. Supplementary appendix on corrosion and pH control included.

326 WATER CONDITIONING — Hall Laboratories Inc, 300 Ross St, Pittsburgh, Pa. 8-page leaflet discusses maintenance of a protective film, control of alkalinity, and prevention of embrittlement and deposits in the boiler.

327 WATER TREATMENT — Oakite Products Inc, 22 Thames St, New York, N. Y. 20-page manual describes Oakite Compound No. 32, a special material reported to combine high scale and rust removing properties with greater safety to equipment than is possible with commercial raw acids. Also discusses periodical removal of insulating scale and rust from diesel, gas and gasoline engines, water-cooled compressors and transformers.

328 WATER TREATMENT — Water Treatment Co of America, 1161 Hodgkiss St, Pittsburgh, Pa. New bulletin entitled "Balancing Boiler Feed Waters the Natural Way with Baerite" describes how Baerite organic formulas condition water so that rust, scale and corrosion do not result in commercial or industrial water applications.

329 WATER SOFTENERS — Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill. Revised 16-page bulletin No. 602 describes various types of water softeners. Describes the Elgin "Double Check" water softener. Also explains how "Double Check" System can be applied to modernize zeolite softeners. Other subjects covered are iron removal, filtration, taste and odor removal, aeration and boiler-water conditioning.

330 WATER TREATMENT — Water Treatment Co of America, 1161 Hodgkiss St, Pittsburgh, Pa. 8-page Baerite Bulletin No. 16 analyzes the reasons for supplementary treatment to prevent scale, corrosion, foaming, priming and caustic embrittlement after treated water is used for boiler feed.

331 WATER-CONDITIONING — Hall Laboratories Inc, Pittsburgh, Pa. 16-page book entitled "Monongahela River-Steel Plant Water Supply" discusses character-influencing factors of river water, geology, industry, mine sealing, flood-control dams and sewage disposal as well as water-conditioning problems involved in its use particularly in boiler feedwater and cooling-water systems.

332 EJECTORS—Elliott Co, Jeannette, Pa. 32-page bulletin G-7 explains the theory and operation of ejectors, single- and multi-stage, illustrated with many shop and installation views. Curves giving air and water

(Continued on page 132)

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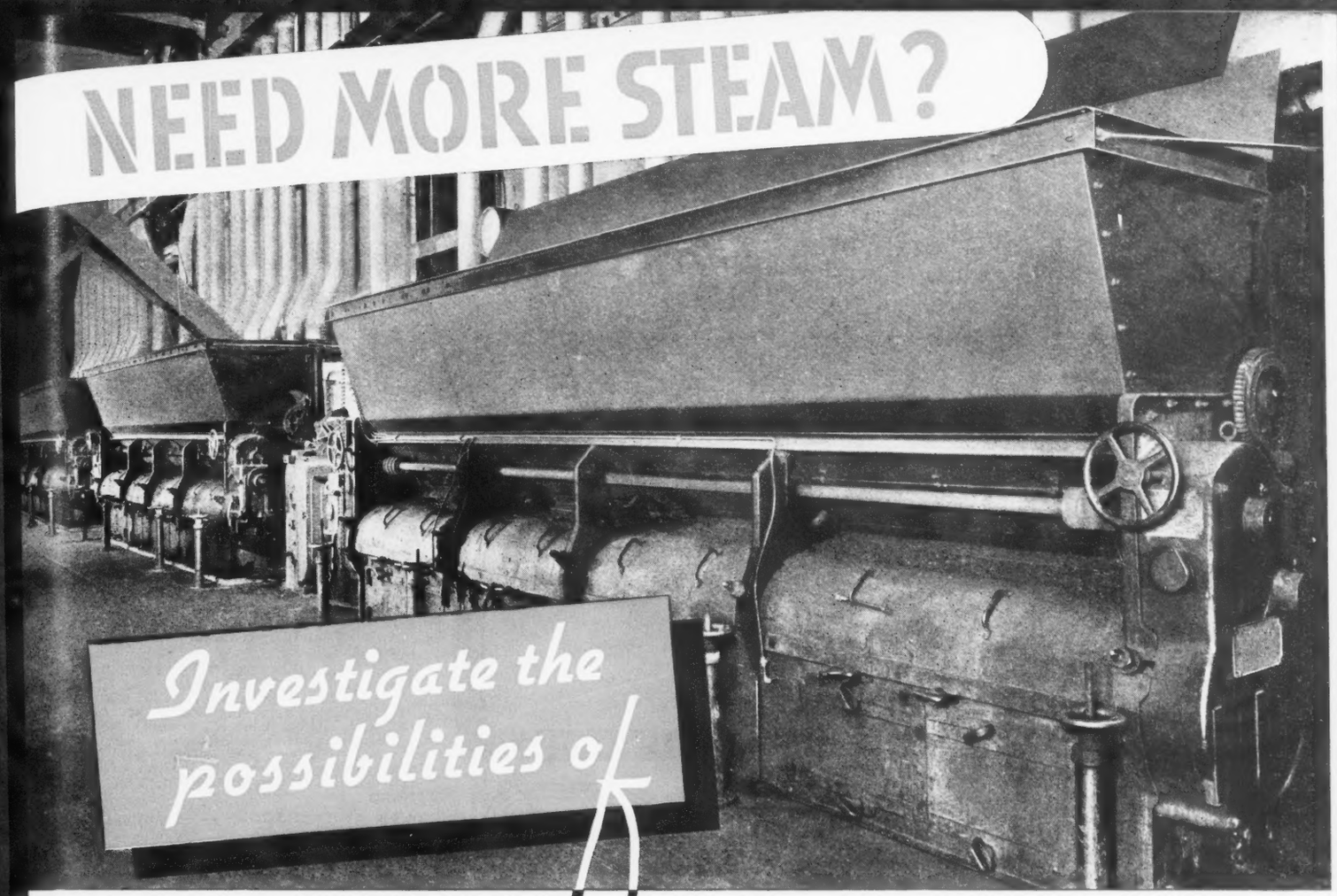

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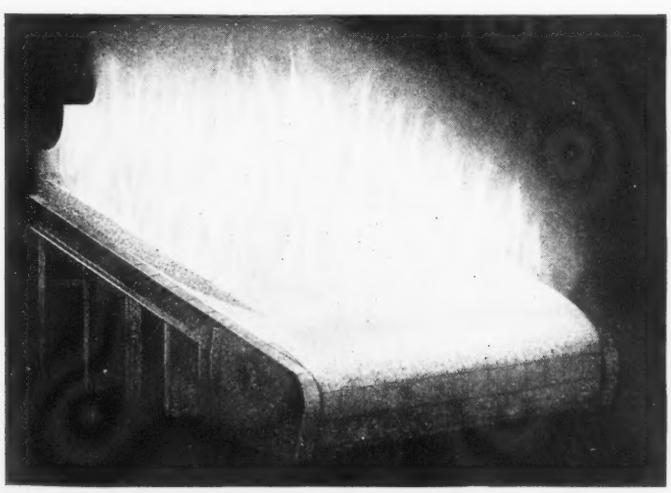

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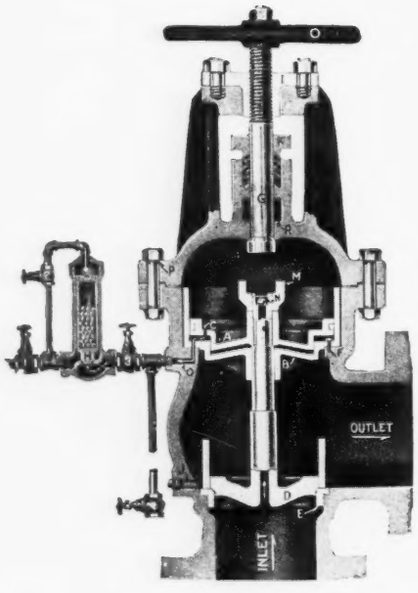

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vapor mixture data and pressure-temperature conversion table are included.

333 WATER TREATMENT—D W Haering & Co, Inc, 2308 S Winchester Ave, Chicago, Ill. Reprint of article "Study of Water Problems in Atmospheric Cooling Systems", discusses the fundamental principles involved. Illustrations and complete description of six laboratory cooling systems used for research are presented.

334 WATER TREATMENT — American Water Softener Co, Lehigh Ave & Fourth St, Philadelphia, Pa. 2-page folder illustrates and describes different types of mobile purification units made by company. Shows and describes Model A, mounted on skids; Model B mounted on trailer; and Model C, mounted on truck.

335 WATER TREATMENT — D W Haering & Co, Inc, Chicago, Ill. 8-page bulletin entitled "The Solution to Your Problem" describes latest developments in proportioning and sampling equipment. Well-illustrated with diagrams, installation photographs and tables.

336 WATER TREATMENT — Elgin Softener Corp, Elgin, Ill. Bulletin No. 605 describes company's line of "Double-Check" zeolite water softeners. Enlarged views of nozzles and other design features show how loss of zeolite is prevented and how faster backwash is possible.

337 FEEDWATER TREATMENT — Allis-Chalmers Mfg Co, Milwaukee, Wis. Bulletin B-6133 entitled "Feedwater Facts—the Story of Allis-Chalmers Akon Service" is novel picture presentation covering feedwater problems common to power plant. Deals with prevention of scale and elimination of carryover, caustic embrittlement, and corrosion.

338 DEAERATORS — Cochrane Corp, Philadelphia, Pa. 36-page catalog includes flow and line diagrams, photographs, etc, showing feature of company's deaerators and accessory equipment. Also explains metering deaerators equipped with V-notch recorders and electrical systems for recording flow from a distance.

339 WATER TREATMENT—National Technical Laboratories, South Pasadena, Calif. 12-page booklet entitled "What Every Executive Should Know About pH" gives a quick, not-too-technical, picture of what pH is and how it may be used to advantage to lower production costs, improve product quality, reduce corrosion and maintenance.

340 WATER TREATMENT — Water Service Laboratories, Inc, 423 West 126th St, New York, N. Y. Bulletin entitled, "What to Do About Water-Pipe Corrosion" describes causes of pipe corrosion and the effect of corrosive waters on iron and brass piping. How to overcome and prevent resultant nuisances such as rusty water, diminished flow, leaks and breaks also discussed.

341 WATER TREATMENT — Cyrus W Rice Co, Pittsburgh, Pa. Booklet entitled "Silica vs. Phoscaloid" is story of development of phoscaloid and its use in lime-soda softening plants.

342 WATER TREATMENT — American K A T Corp, 122 East 42nd St, New York, N. Y. 8-page folder presents organic colloidal principle of water treatment, problems involved in use of inorganic chemicals, and trend in modern feedwater treatment practice, as well as advantages of K A T treatment, what it does, and some laboratory reports on product.

343 WATER TREATMENT — Water Treatment Co of America, 1155 Hodgkiss St, Pittsburgh, Pa. 8-page technical bulletin describes supplementary boiler-water-treatment service for soda ash and lime and Zeolite water coagulants, known as Baerite-16. Manufacturer claims compound will remove all scale, rust, and corrosion from boilers in about one-fourth time required by other methods.

344 BOILER-WATER CONDITIONING—Proportioneers, Inc, Providence, R. I. 14-page brochure No. 122 presents standard methods on complete chemical treating equipment for the power plant. Typical installations show various types of equipment used.

345 WATER TREATMENT — American Sand-Banum Co, 9 Rockefeller Plaza, New York, N. Y. 4-page leaflet describes application of Sand-Banum to solve corrosion problems in refrigerating plants. Instructions for use included.

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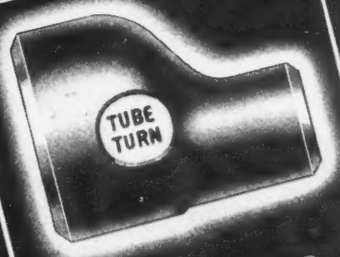

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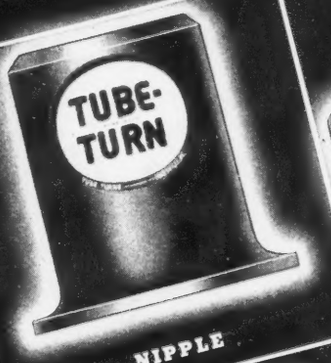

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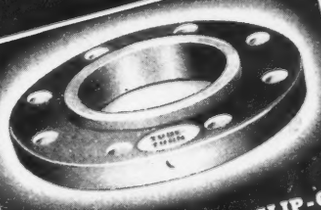
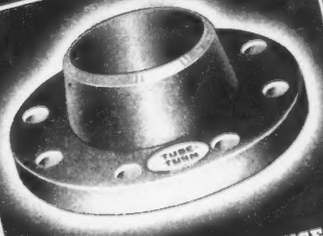


SLIP-ON FLANGE



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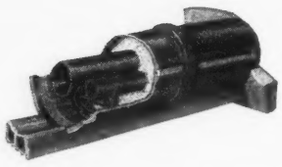

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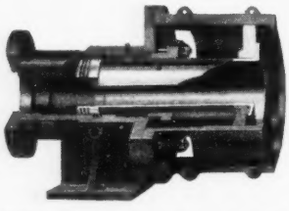
A strong, vitrified conduit for underground steam and hot water lines. Easily split on the job with a clean-cut fracture. Available with or without base drain in sizes from 4-24". Write for Bulletin 35-67D.



ADSCO Piston-Ring Expansion Joint

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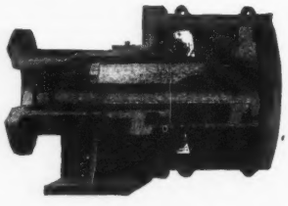

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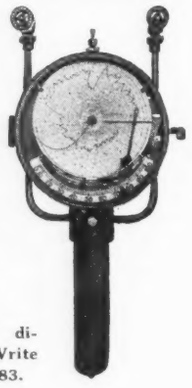
Both ends of slip guided throughout entire traverse. Available in single or double joints for high pressures and high temperatures; flanged or beveled ends. Write for Bulletin 35-20A.

ADSCO Heaters and Economizers

ADSCO builds all sizes and types of heaters, preheaters and economizers, for oil, water or other liquids. Storage or instantaneous—horizontal or vertical—U-Bend or Straight Tube. Write for Bulletins 35-75D and 35-76D.



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Orifice type. Accurately meters steam, water, air or gas. Free floating, frictionless meter mechanism. Transmits flow to direct reading, evenly divided chart. Write for Bulletin 35-83.

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AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, NEW YORK

346 CHEMICAL PROPORTIONER — Cochrane Corp, 17th St & Allegheny Ave, Philadelphia, Pa. Publication 3015 covers details of proportioner design, construction and application, with flow diagrams, of Cochrane flow meters to typical water-conditioning-control applications.

347 DESK-TOP TEST—Water Treatment Company of America, 1159 Hodgkiss St, Pittsburgh, Pa. Consists of small bottle of "Baerite" and a rusty screw. Automatic disappearance of rust in two or three days demonstrates one application of "Baerite" water treatment, which is used for rust, scale, corrosion, foaming, priming and other water difficulties.

348 WATER TREATMENT — Cochrane Corp., Philadelphia, Pa. 48-page catalog No. 3000 on hot-process water softeners for removal of silica, etc, from boiler feedwater. Contains 9-page appendix of feedwater chemistry, in addition to heat balances, flow diagrams, construction drawings, engineering tables and charts.

WELDING

349 ARC WELDING — Hobart Bros Co, Troy, Ohio. 40-page vest-pocket checking pad answers many questions regarding arc welding with photographs illustrating about 23 typical applications for possible use and benefit by manufacturers.

350 ARC WELDING COST—Air Reduction Co, 60 East 42nd Street, New York, N. Y. 6-page booklet tells how many pounds of electrodes are required per linear foot of welds. Calculator includes consumption figures for both bare and shielded-arc electrodes on all metal thicknesses commonly employed in making fillet welds, square groove butt joints, bevel grooves, etc. Basic formulae used are included.

351 ARC WELDERS—Hobart Brothers Co, Troy, Ohio. 38-page catalog covers complete line of Hobart "Simplified" arc welders and accessories with numerous photographs of actual installations as well as diagrams of machines.

352 ARC-WELDING SYSTEMS—General Electric Co, Schenectady, N. Y. GEA-569F describes and illustrates G E multiple-operator arc welding systems for manual or machine welding with metallic or carbon electrodes.

353 ARC WELDING—Air Reduction Sales Co, 60 East 42nd St, New York, N. Y. 16-page folder has to do with welding for building construction. Airlines Terminal Building in New York is described with relation to the use of arc welding.

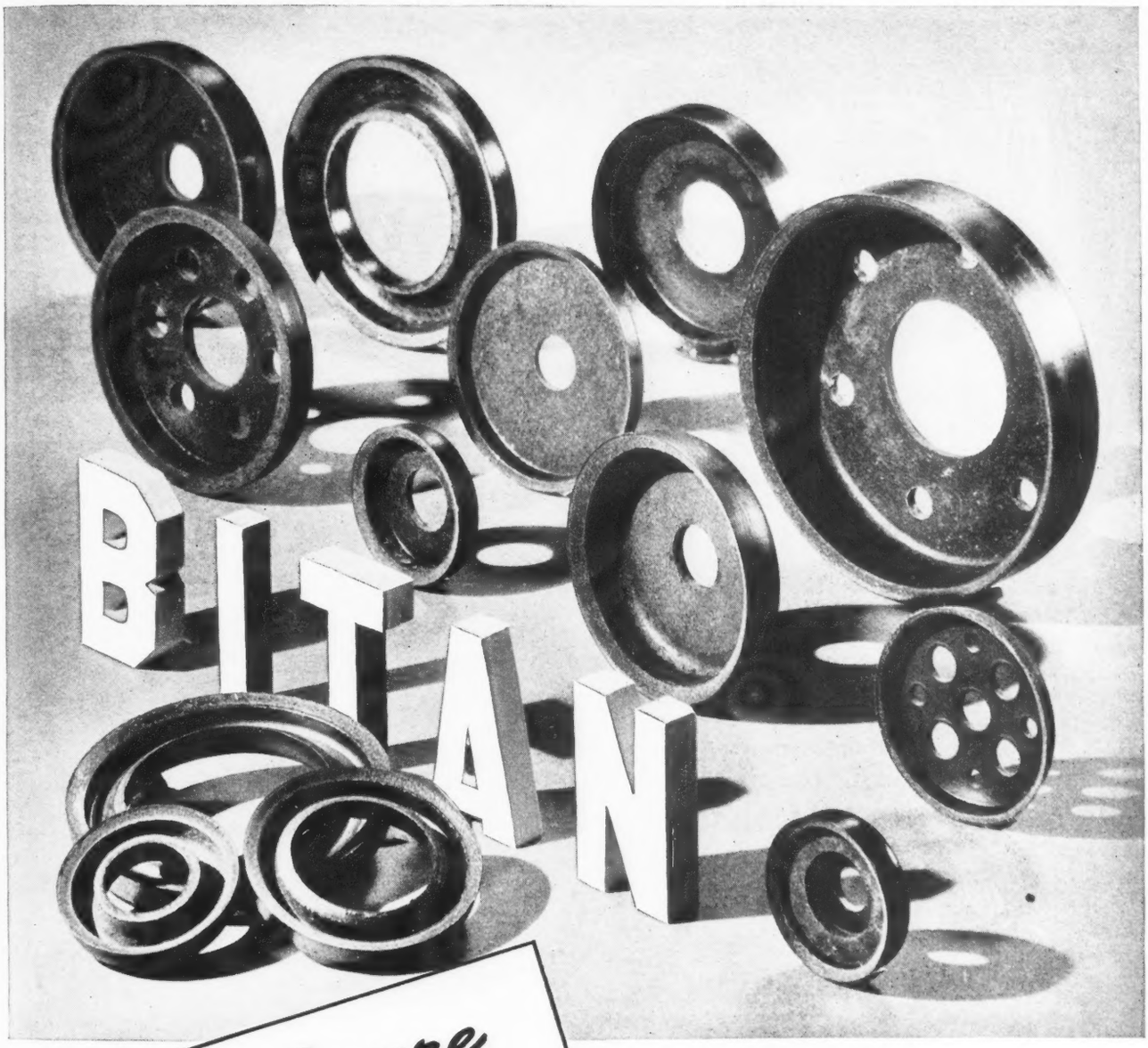
354 WELDING — Westinghouse Electric & Mfg Co, East Pittsburgh, Pa. 4-page leaflet gives useful information on technique of seam and spot welding. Factors affecting pressure, current and timing discussed with emphasis on time of current flow. Specifications for aluminum and brass welding given, and tables list data on seam-welding mild, pickled and oiled steel, and projection welding.

355 WELDING POSITIONERS—Cullen-Friestedt Co, 1300 South Kilbourn Ave, Chicago, Ill. 12-page bulletin WP-20 describes complete line of C-F welding positioners. Study of factors involved in handling of objects to be welded is included, with many illustrations showing positioners in use.

356 WEDGE PRODUCTS — Wedge Protectors, Inc, 9522 Richmond Ave, Cleveland, Ohio. 16-page folder describes complete line of Wedge products, including pipe tubing and casing protectors, tin plugs, chill rings for welding, and sucker rod protectors.

357 ARC WELDER — Westinghouse Electric & Mfg Co, East Pittsburgh, Pa. 4-page folder 26-320 describes construction and operational features of "Midget Marvel Flexarc" ac welder. Photographs of welder are included, and outstanding features pointed out. Internal construction is discussed and illustrated.

358 WELDING CALCULATOR — Champion Rivet Co, Harvard Ave and East 108th St, Cleveland, Ohio. Slide-rule-type welding cost-calculator gives, when definite welding procedure is used, guides to figure individual welding costs.



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Please tell me how "Baerite" duplicates Nature's method of "balancing" water.
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OTHER

359 WIRE SCREEN CLOTH—Robins Conveying Belt Co, Passaic, N. J. 8-page Bulletin No. 113 describes company's woven wire screen cloth, its metallurgy, important specifications and data, special metals, sizes, shapes and finishes. Also contains specification tables.

360 SYNTHETIC RUBBER — B F Goodrich Co, Akron, Ohio. 8-page feeder discusses Ameripol D, synthetic rubber, used in making mechanical rubber products, its properties, hardness tensile strength, elongation, weight, color, odor and taste, elasticity and permanent set, tear and abrasion resistance, resistance to flexing, oils, solvents and heat.

361 BLUEPRINTING MACHINE — C F Pease Co, 2601 W Irving Park Road, Chicago, Ill. 4-page folder illustrates and describes Model 22-16 combination blueprinter, washer and dryer. Describes features of each machine individually and points out advantages of combination.

362 CARBURIZING—Leeds & Northrup Co, Stenton Ave, Philadelphia, Pa. 26-page catalog T-623 takes reader on pictorial tour showing heat-treating process; shows furnaces in action and various types of work being carburized.

363 DATA SHEETS—Ampco Metal, Inc, Milwaukee, Wis. 56-page book of data sheets covers numerous subjects, including phase-concentration-control, centrifugal castings, machining recommendations, etc.

364 DISPERSION DRYER—Western Precipitation Corp, 1016 W Ninth St, Los Angeles, Calif. 8-page bulletin features Turbulaire dispersion dryer, used for drying slimes, pulps, colloids, etc, which cannot be filtered. Points out varying range of application for dryers.

365 DRAFTING ROOM EQUIPMENT —C F Pease Co, Chicago, Ill. 156-page spiral-bound book illustrates company's complete line of products; includes blueprinting machinery, blueprint paper, Multazo direct-process paper, drafting-room furniture, photographic arc lamps and related equipment.

366 ENGINEERING SERVICES—E J Cheney & Co, New York, N. Y. 4-page leaflet outlines scope of 20-year-old company's services to industrial, construction and public-service organizations.

367 FLOOR GRATING — Walter Bates Co, 208 S La Salle St, Chicago, Ill. 12-page catalog No. 937 describes and illustrates Bates floor grating, stair treads, floor armor and bridge decking. Numerous unretouched application photos included.

368 GRATING—Wm F Klemp Co, 6601 S Melvina Ave, Chicago, Ill. 8-page folder No. 14-R describes Klemp floor products, including open steel flooring, grating, grating flooring, stair treads, heavy-duty industrial traffic surfaces, bridge, ramp and loading-platforms flooring, floor armor, decking and armor grids.

369 FLUORESCENT FIXTURES — Mitchell Mfg Co, 2525 Clybourn Ave, Chicago, Ill. Pocket catalog No. 240 pictures entire line of commercial and industrial fixtures, with brief engineering and sales data on each.

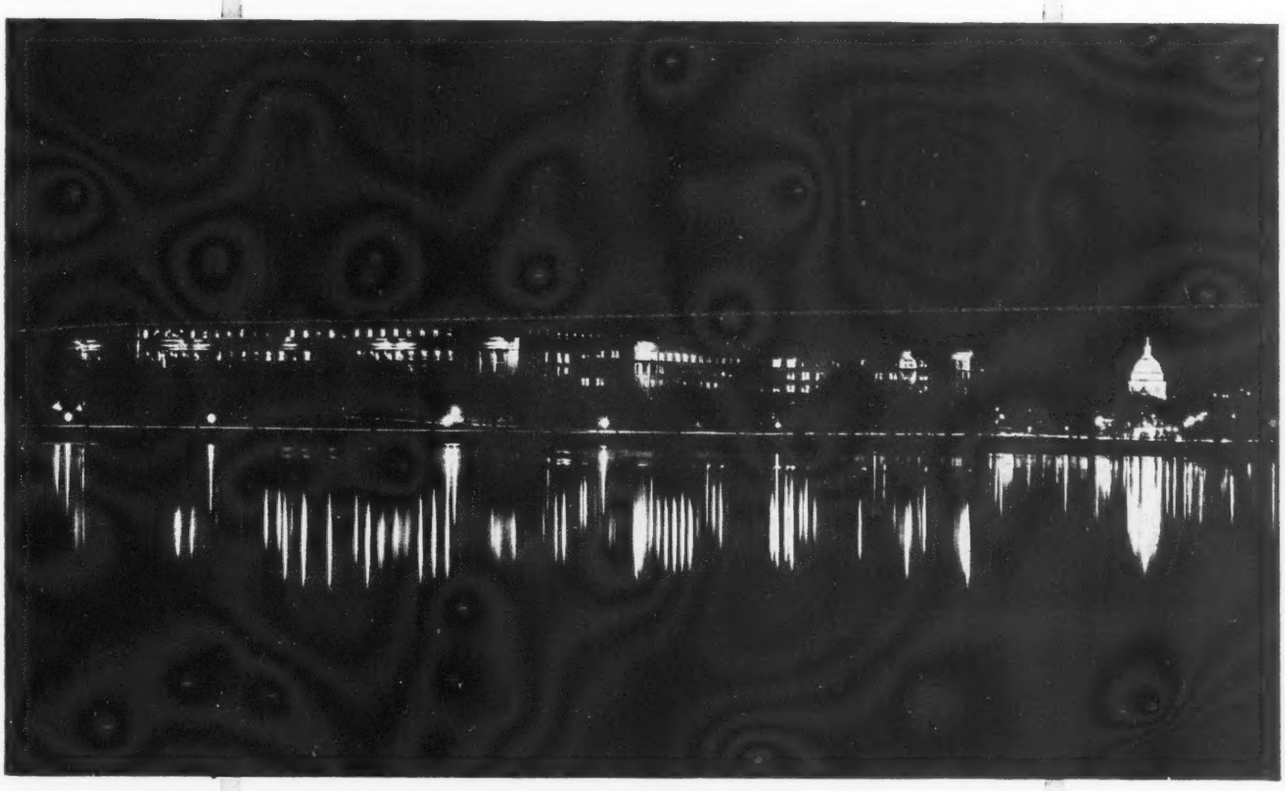
370 FUNCTIONAL FLOOR DESIGN —Open Steel Flooring Institute, Inc, Dept D, American Bank Bldg, Pittsburgh, Pa. 12-page booklet is handbook for architects and engineers on uses and properties of open-steel grating for floors, stair treads, walkways, ventilators, sidewalk grating and platform construction. Hypothetical layout pictured.

371 LENSES — Holophane Co, 342 Madison Ave, New York, N. Y. 16-page bulletin describes three Controlenses with different light characteristics for use with fluorescent lamps. Describes optical performance of each, lists advantages and shows how results can be predicted. Also illustrates design equipment using lenses.

372 PILOT LIGHTS—Dial Light Co of America, 90 West St, New York, N. Y. 8-page bulletin lists, describes and illustrates many types of pilot-light assemblies including special enclosed lamps, and standard setups with removable parts.

373 PILOT LIGHTS — Signal Indicator Corp, 140 Cedar St, New York, N. Y. 4-page folder illustrates and describes all types of pilot light assemblies, giving sizes available, and prices of each.

★ COAL ★



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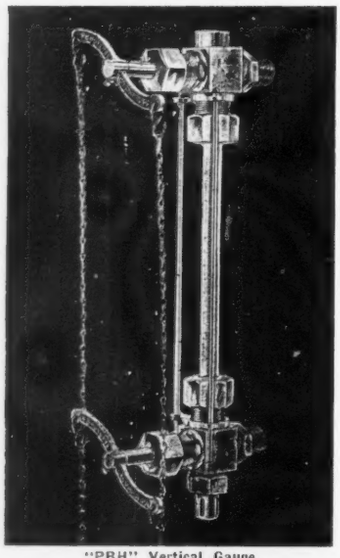
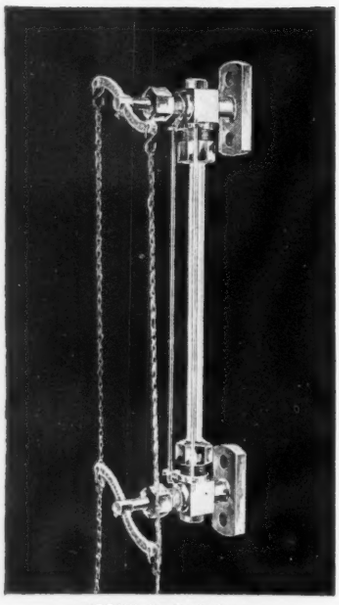
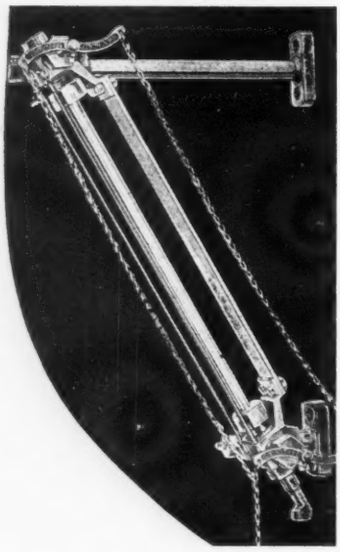
HUYETTE WATER GAUGES



"PBH" Vertical Gauge
(screwed connection)



"PBH" Vertical Gauge
(Flanged connection)
"PBH" Tiltview Gauge (Patented)



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All "PBH" valves are polished, well proportioned, of heavy bronze alloy according to A.S.M.E. Code and stamped with maximum working pressure. Glass and stem nuts are large to accommodate ample size packings, insuring steam-proof and leak-tight service.

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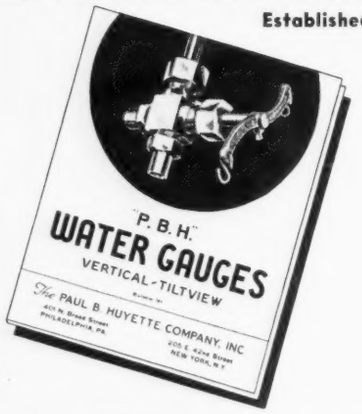


GET THIS DATA SHEET!

Our new bulletin No. 741 gives complete data and specifications on all "PBH" Water Gauges. Sizes, working pressures and pipe connections are included together with complete illustrations. Your letterhead will secure you a copy—write today.

374 POWER PLANT INSURANCE—Hartford Steam Boiler Inspection and Insurance Co, Hartford, Conn. 8-page folder outlines coverage of policies written by company, and services available to policyholders. Comparative chart showing amount of policies written by competitive companies included.

375 PROCESS TIMERS — National Time & Signal Corp, 600 E. Milwaukee Ave, Detroit, Mich. 8-page bulletin covers timers for all processes, including those for spot-welding operations and other cyclic uses. Each model described in detail with photos showing essential parts.

376 PROCESS EQUIPMENT — Patterson-Kelley Co, East Stroudsburg, Pa. 8-page folder shows tanks and pressure vessels, kettles, mixers, heat exchangers, and miscellaneous equipment of chemical and process industries.

377 SPONTANEOUS - COMBUSTION INDICATOR—Coal Specialties Co, 50 Church St, New York, N. Y. 2-page leaflet describes "Hot Spot Indicators" for indication of excess temperatures in coal piles. Explains spontaneous combustion and shows how it can be overcome.

378 SYMBOL CHART — Frederick Post Co, Box 803, Chicago, Ill. Wall chart contains 249 engineering symbols, including standard and "hard-to-find" items. Sent free only to interested drafting and designing engineers.

379 PROPERTY CHART — American Lava Corp, Chattanooga, Tenn. Wall-chart gives specific gravity, density, volume, color, hardness and other properties of ceramic insulating materials, including Steatite, Cordierite and lava bodies.

NEWS BRIEFS

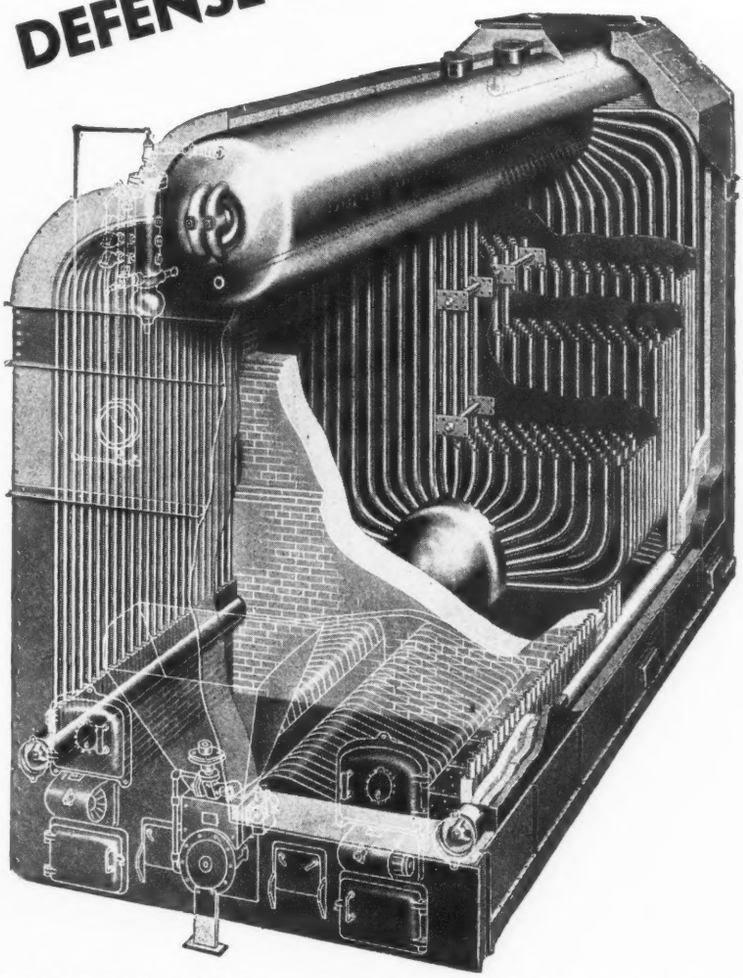
Welding Society Awards Miller and Lincoln Medals

Presentation of the 1941 Miller Memorial Award and the Lincoln Gold Medal for 1940–41 featured the opening session of the American Welding Society's annual meeting, Bellevue-Stratford Hotel, Philadelphia, Pa., October 20.

The Samuel Wylie Miller Memorial Medal was awarded to David Arnott, vice-president and chief surveyor of the

David Arnott, vice-president and chief surveyor of the American Bureau of Shipping, New York, N. Y., and second vice-president of the American Welding Society, winner of the Samuel Wylie Miller Memorial Medal for 1941.

DEFENSE PUTS THE OK ON KEELER



TYPE CP STEAM GENERATOR

77 YEARS OF BUILDING BETTER BOILERS

—and its 77 years of building better boilers

Companies engaged in defense production realize, more fully than all others, the necessity of reliable and efficient boiler operation. In this emergency, when every pound of steam counts, Keeler boilers and Keeler service are meeting the demands of the day.

★ Keeler's case histories are filled with service and performance records where Type CP Steam Generators are proving their worth to manufacturers engaged in defense contracts.

★ In one of the country's largest metal corporations* a total of thirten Keeler CP Generators rated at 3950 HP make possible an output that dwarfs peacetime production.

★ Another Keeler case history concerns a large manufacturer* normally engaged in making floor covering materials, now devoting its facilities to the production of millions of artillery shells. Eleven CP boilers totalling 3600 HP, purchased on six separate orders, are operating in several of this company's plants.

★ Over 600 Keeler CP Steam Generators are now in use in the U.S. and Canada. Compare these CP features with your requirements:

*—Name on request

Completely Steel cased and insulated
Water-cooled side walls
Built-in soot blowers
Unrestricted circulation
Steady water level
Dry steam at all ratings
Requires less head room
Requires less floor space
Longer gas travel, higher efficiency
More steam space and water storage
Capacities to 50,000 lb. . . . pressures to 450 lb.

Manufactured and sold in Canada by Canadian Vickers, Ltd., Montreal

E. KEELER CO., WILLIAMSPORT, PENNA.

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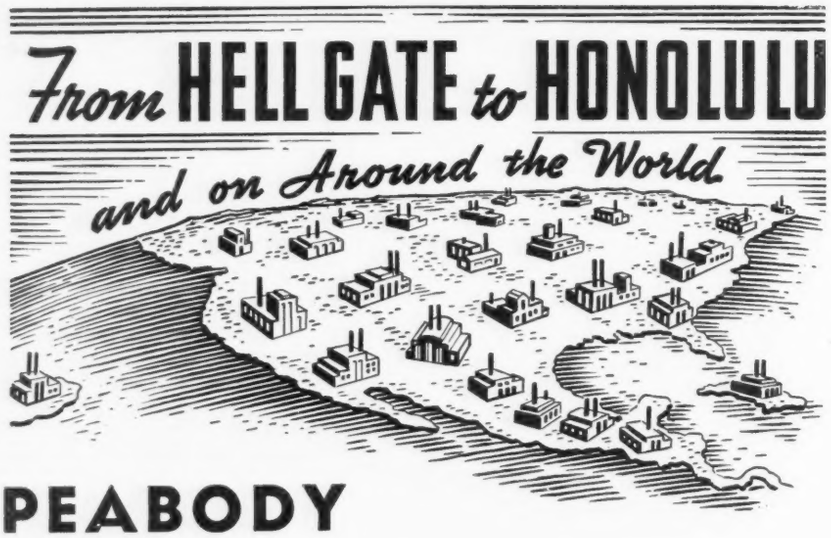
E. KEELER CO.

BUILDERS OF BETTER BOILERS SINCE 1864

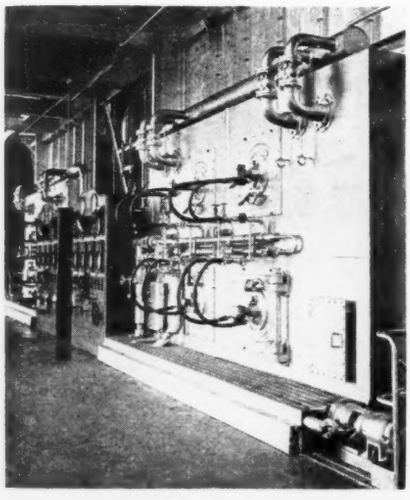
WILLIAMSPORT, PENNA.



PEABODY BURNERS Are on the Job

Wherever Electric Power is Generated by Steam

Central Stations firing oil, gas, pulverized coal and even waste fuels use Peabody Burners because of their long established reliability and proven efficiency.



56 NEW Central Station INSTALLATIONS

have been purchased in recent months for public utility service in power generating plants throughout the Americas and in the Hawaiian Islands. Of these, one-half were repeat orders, the best possible evidence of satisfactory performance and of confidence in Peabody equipment.

Because electric service must be dependable, because fuels must be fully utilized, because output must follow the load curve wherever it goes, the Electric Industry chooses Peabody Burners; built by an organization that has concentrated for decades on improvement in design and performance of combustion equipment.

Profit by the experience of those whose primary business is the generation of power and standardize on Peabody combustion equipment. Peabody engineers welcome opportunities to study your requirements and to submit recommendations.

PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK
OFFICES IN PRINCIPAL CITIES

American Bureau of Shipping, New York, and second vice-president of the American Welding Society. Award of the Lincoln Gold Medal, donated to the American Welding Society by James F Lincoln, president of The Lincoln Electric Co, Cleveland, Ohio, was made to Robert H Aborn, member of the staff of the Research Laboratory of the United States Steel Corp, Kearny, N. J.

The award of the Miller Medal was made for conspicuous contributions to the art and science of welding during Mr Arnott's long service with the American Bureau of Shipping which he joined in 1918. Mr Arnott has been a most important factor in the progress of welding in ship construction.

David Arnott was born in Glasgow, Scotland, in 1878. He received his education at the Royal Technical College in Glasgow and served his apprenticeship in shipbuilding at the Fairfield Shipbuilding and Engineering Co, Ltd, Glasgow. In 1901 he was appointed a surveyor of the British Corporation for the Survey and Registry of Shipping, a position which he held in the head office in Glasgow until 1917. In that year he was appointed the Society's Principal Surveyor to Canada. In 1918 he came to New York as deputy chief surveyor of the American Bureau of Shipping, a position he held until 1925, when he became chief surveyor. To his duties as chief surveyor were added in 1938 those of vice-president. He still holds both these offices. Mr Arnott became a naturalized citizen of the U.S.A. in 1924.

Technical Affiliations

His affiliations with technical affairs are numerous and include: Council Member, Society of Naval Architects & Marine Engineers; Member, Institution of Naval Architects; Member, British Institute of Welding; Second Vice-President, American Welding Society; Chairman of Committee on Welding in Marine Construction, American Welding Society; Technical Advisor to U. S. Delegation, International Safety of Life at Sea Convention 1929; U. S. Delegate to International Load Line Convention 1930.

He is author of, "Some Examples of Welded Ship Construction," presented before the Society of Naval Architects and Marine Engineers in 1934, and, "Welding in Shipbuilding," delivered last year to the American Welding Society. One of the chapters in the Welding Handbook was contributed by him. In the "Principles of Naval Architecture," published by the Society of Naval Architects and Marine Engineers, he wrote the chapter on "The Strength

CURVES AHEAD

Don't SLOW DOWN

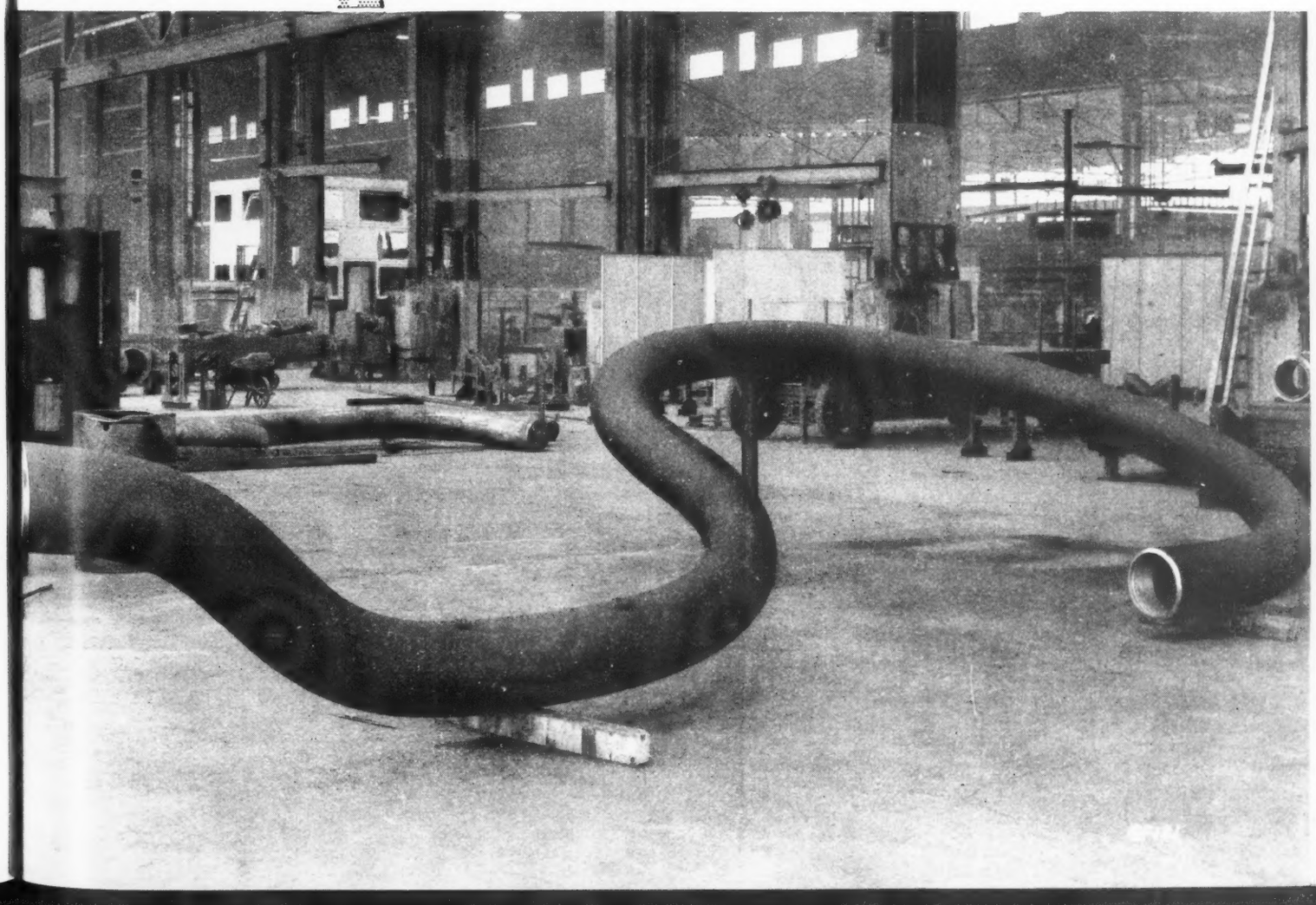
This 45 foot piece of 12¾", .843 carbon moly piping with its complex curves and angles is typical of the vital links in high pressure power systems which Grinnell is building to speed our national defense. Leading manufacturers, utilities and process plants seeking new and expanded power facilities, "Give their plans to Grinnell" for expert interpretation and fabrication of piping.

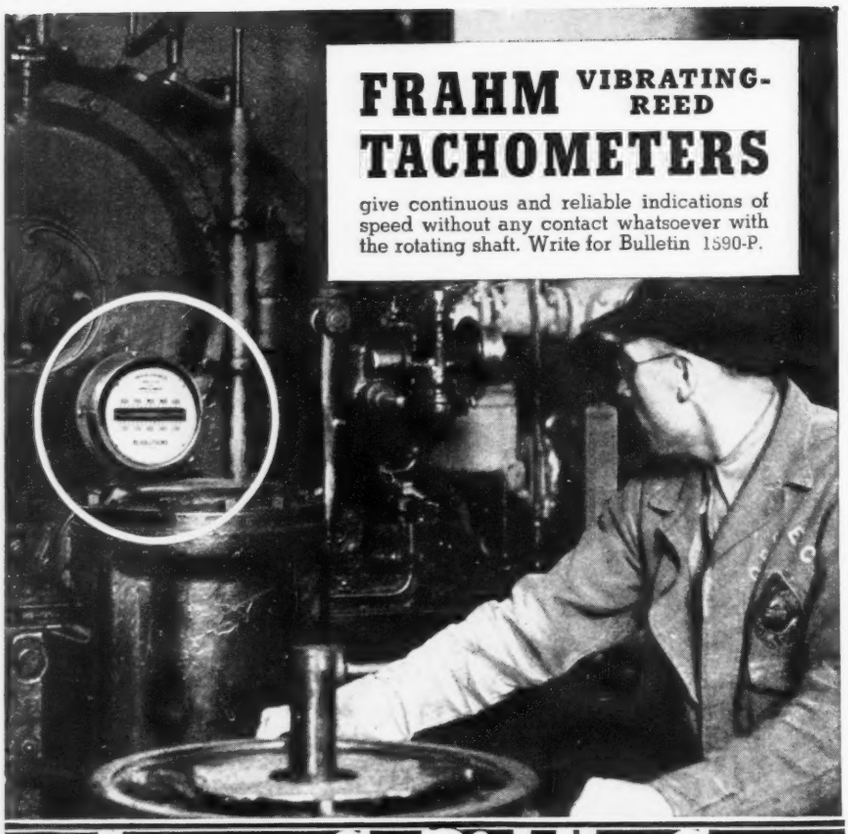
Grinnell engineers are power specialists, qualified by long experience to interpret even the most complex piping requirements into accurate, heavy-duty super-piping systems. Grinnell plants, strategically located to serve the nation, are equipped with every last facility to prefabricate these systems.

Whether your proposed power extension is simple or complex, Grinnell can simplify your piping problem. Write for Data Book, "Grinnell Prefabricated Piping". Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

PREFABRICATED PIPING BY GRINNELL

WHENEVER **PIPING** IS INVOLVED





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give continuous and reliable indications of speed without any contact whatsoever with the rotating shaft. Write for Bulletin 1590-P.

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Many models — in screw and ram types. One for your need. Ask about it.

Frederick Industrial Stokers

Built by The FREDERICK IRON & STEEL CO., Frederick, Maryland . . . "Builders of Good Stokers for Over 23 Years."

COMPLETE LINE OF CENTRIFUGAL PUMPS FOR ALL PURPOSES
STEAM OPERATED ASH CONVEYING SYSTEMS • ASH STORAGE BINS

of Ships." He has written extensively on load lines and the safety of life at sea.

The Lincoln Award, which is presented each year for the paper which contributes most to the year's development of welding, was made for, "Metallurgical Changes at Welded Joints and the Weldability of Steels," published in the October, 1940 issue of *The Welding Journal* and presented at the annual meeting in Cleveland October 21st to 25th, 1940.

Robert H Aborn, member of the staff of the Research Laboratory of the United States Steel Corp., Kearny, N. J., recipient of the Lincoln Gold Medal.

Mr Aborn was born January 9, 1897, at Battle Creek, Michigan. His education consists of an AB degree from Grinnell College in 1918, BS degree from Massachusetts Institute of Technology in 1920 and ScD (in Metallurgy) Massachusetts Institute of Technology in 1925. He was in the Chemical Warfare Service of the U. S. Army in 1918.

During 1920 and 1921, Mr Aborn was in the blast furnace department of the Bethlehem Steel Company and from 1923 to 1925 worked in the laboratory of the Watertown Arsenal. From 1925 to 1928 he was employed in the Z-Ray Division of the Research Laboratory of Applied Chemistry at Massachusetts Institute of Technology. From 1928 to 1930 he was instructor in metallurgy at the Engineering School of Harvard University. He was appointed to his present position on the staff of the Research Laboratory of the U. S. Steel Corp. in 1930.

Gas-Filled Cable for Power Distribution

Low-pressure gas-filled cable combines the advantages of oil-filled cable with the low cost and simplicity of solid-type cable and offers a new means for safeguarding power supplied to defense

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THE INDUSTRY THAT SERVES ALL INDUSTRY

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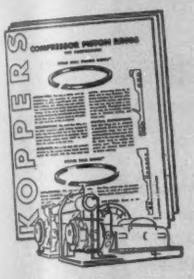
HOW KOPPERS COAL CAN SAVE FOR YOU

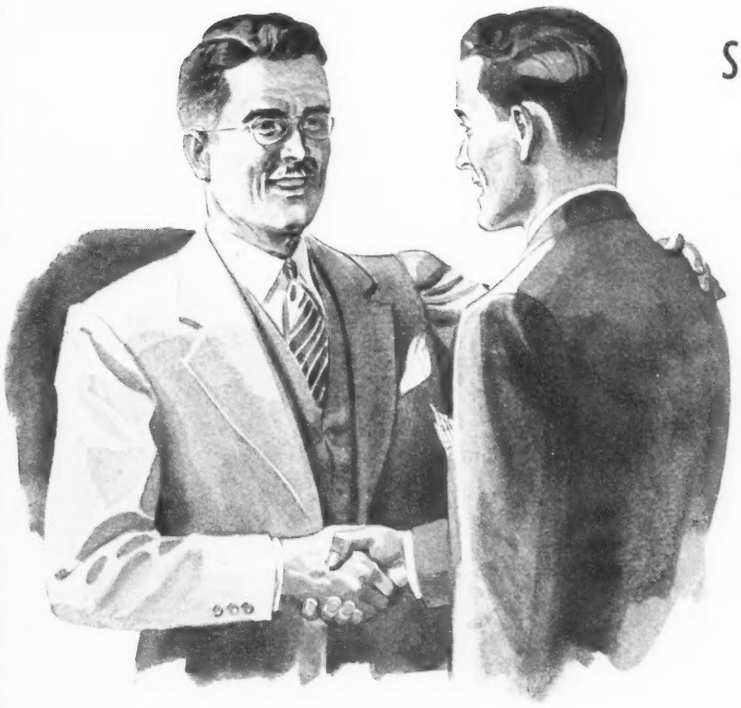


HOW TO GET BETTER COMPRESSOR RING SERVICE

LOW PRESSURE GATE VALVES FOR INDUSTRIAL USE

HOW TO EXTEND LIFE OF ROOFS OR STRUCTURES

. . . and now that you're Maintenance Superintendent, you'll learn why I always insisted on FAST'S COUPLINGS



When promotions shift maintenance responsibilities to new shoulders, there's one sound tip that the "Old Head" often passes on to the new . . . "It will pay you to stick to Fast's Couplings."

The man personally responsible for continuous operation knows that his record depends on keeping dozens of pieces of complex equipment going. Couplings are vital links in the power-transmission chain. Practical operating men have learned, from many years experience, that they can depend on "Fast's" . . . and that the only economical coupling is the dependable one.

When you purchase new machinery—protect yourself against possible operating troubles, by specifying *genuine* Fast's Couplings.

KOPPERS COMPANY
BARTLETT HAYWARD DIVISION
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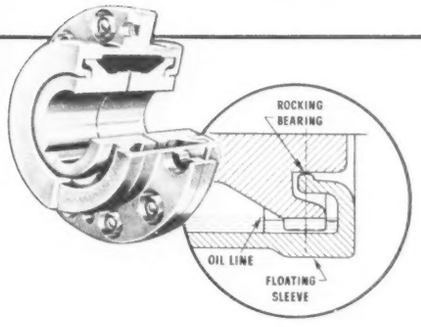

These cut-away and sectional views show Fast's exclusive design. The load carrying surfaces are protected against wear by a positive film of oil. This oil is kept permanently clean by rocking bearings which make precise metal-to-metal contact and are in the one position where they form permanent dust and moisture-proof seals. Only *genuine* Fast's Couplings have this feature.

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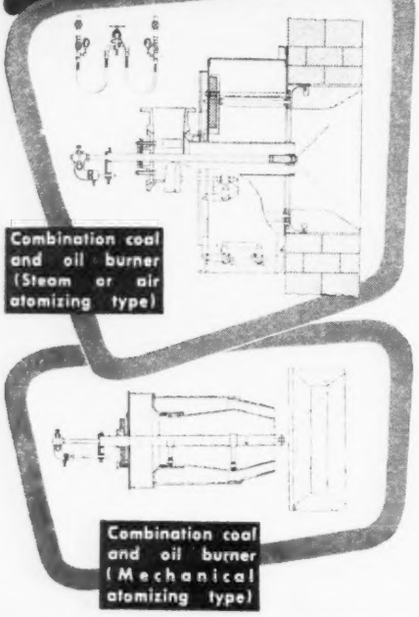
6 REASONS

why POWER PLANTS burning pulverized coal should be equipped with Enco OIL BURNERS


Combination coal and oil burner (Steam or air atomizing type)
Combination coal and oil burner (Mechanical atomizing type)

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An Enco System gives you these important advantages . . .

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Enco's list of installations reads like a who's who of American Industry. We will gladly show how Enco Oil Burning Equipment can be used with your present pulverized coal burners—there's no obligation. Write The Engineer Company, 75 West Street, New York, N. Y.

Enco Burners

industries. V A Sheals, assistant cable design engineer, General Electric Co. told a recent joint meeting of the American Institute of Electrical Engineers and the Louisiana Engineering Society in New Orleans.

The gas-filled cable is a new development, although installations totalling 140,000 ft have been made, according to Mr Sheals. It is housed in a lead sheath filled with dry nitrogen at a pressure of between 10 to 15 lb per sq in. Any damage to the cable sheath sufficient to cause a leak lowers the pressure and sets off an alarm at the power station. The leak can then either be investigated immediately and repairs made to avoid service failure, or, if the leak is small, additional gas can be fed into the cable from standby high-pressure cylinders and repairs postponed until a more convenient time.

Field of Application

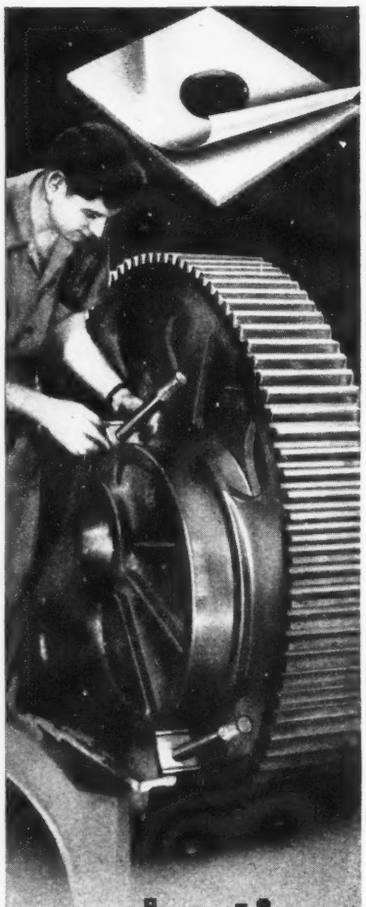
Mr Sheals said that the cable's logical field of application is for important tie lines and feeders at voltages from 10 to 40 kv. Pointing out that in these days it is often necessary to load cables to the limit, he stated that the gas-filled type will stand maximum loads without deteriorating as would the solid type.

Gas-filled cable can be used much more safely where only one feeder can be installed and reliability of service is essential, as it is in many cases, particularly for defense loads, Mr Sheals said. Of course, a direct hit by a bomb or a steam shovel digging into a duct bank could cause a failure without warning, but any other types of attempted sabotage or leaks would be detected.

In discussing the development of low-pressure gas-filled cable Mr Sheals said that the success of oil-filled cable had proved conclusively the value of maintaining positive pressure during shipment, installation, and service. As a result, pressure maintenance was the foremost consideration in designing the new-type cable. Gas was selected as the pressure medium because it appeared to be the simplest to establish and maintain. Problems of hydrostatic head pressures due to steep profiles would be eliminated. Accessory designs could be extremely simple if relatively low pressures could be used.

Dry nitrogen with a negligible amount of oxygen was selected as the best gas to prevent oxidation or other chemical deterioration.

Mr Sheals said that the cable is shipped from the factory with a gas pressure of about 8 to 10 lb, and this



production insurance

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Write for file-folder of shim application photos—and Laminum sample.

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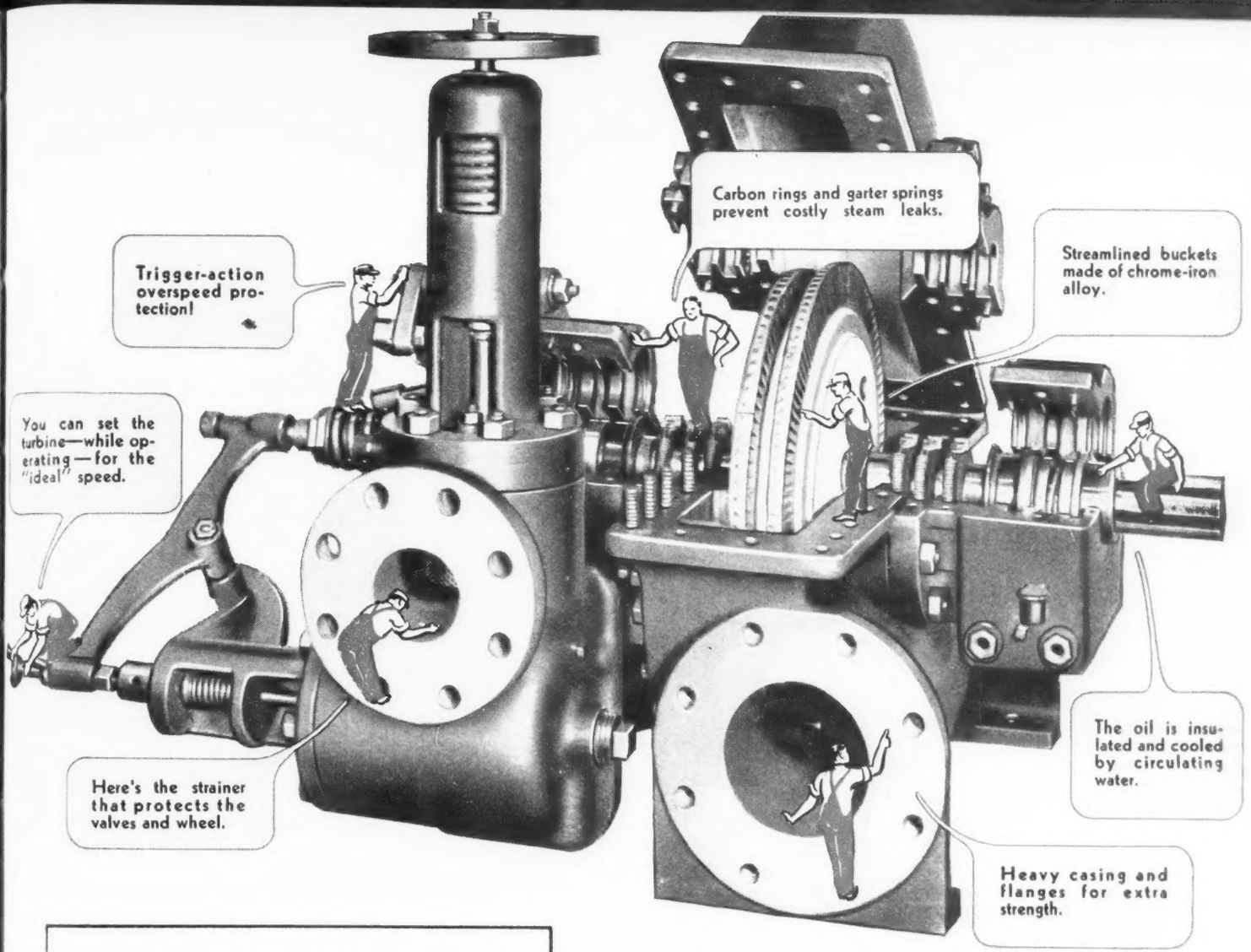
Carbon rings and garter springs prevent costly steam leaks.
Trigger-action overspeed protection!
Streamlined buckets made of chrome-iron alloy.
You can set the turbine—while operating—for the "ideal" speed.
Here's the strainer that protects the valves and wheel.
The oil is insulated and cooled by circulating water.
Heavy casing and flanges for extra strength.

WHETHER IT'S A 40- OR 160-HOUR WEEK, IT PAYS TO USE TURBINES WHERE . . .

- ★ **low-pressure steam is used.** In a variety of industries, such as oil refineries, chemical plants, and paper and textile mills, turbines reduce high-pressure steam to process pressures while producing low-cost by-product power.
- ★ **reliable drives are essential.** Circulating, condensate, and boiler-feed pumps; forced-draft and induced-draft fans; coal stokers and pulverizers are but a few that require never-failing operation.
- ★ **dependable stand-by power is required** for fire pumps, emergency boiler-feed pumps, exciters, and similar auxiliaries. No preliminary "warming-up" period is necessary.
- ★ **hazards of explosion are present.**
- ★ **a range of speed is required.**
- ★ **the speed must be adjusted automatically** as required, to control pump or fan discharge pressure.
- ★ **unfavorable atmospheric conditions exist,** such as dampness and high ambient temperatures.

It's Easy to See Why

Type D Mechanical-drive Turbines Last the L-o-n-g-e-s-t

With pumps, fans, and compressors required to run continuously for longer periods these days, dependable drives are necessary for defense against shutdowns. To meet today's increased production requirements you'll find it pays to go Type D—to *use G-E mechanical-drive turbines to drive your important apparatus in which some "weak link" may limit production.*

This now-better-than-ever turbine has a strainer to prevent entrance of foreign materials, a combined trip and throttle valve to assure protection against overspeed, and ring-lubricated bearings with the oil supply insulated and cooled by circulating water. Add to these exclusive advantages the chrome-alloy buckets, the dynamically balanced rotor, the sustained efficiency, and the carbon packing glands that reduce steam loss—and you'll realize why Type D drives avoid wasted money and valuable time through shutdowns.

As production gains more speed, more power will be needed. Remember, there's a G-E turbine specialist near who can show you how to get economical power as a by-product of steam. Enlist his help. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

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GASKETS THAT WILL FIT EXACTLY

Red Lip-mold Pattern Expansion Type Gasket

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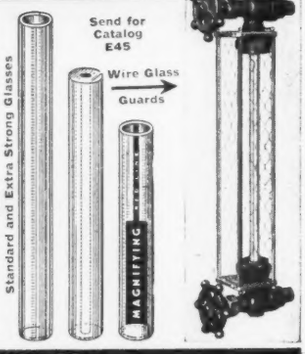

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That We Might Say 'YES'
TOMORROW...

A Message To Our Industrial Power Customers:

★ In the past 30 years we've built and delivered well over a MILLION Viking Rotary Pumps. Some called for special metals, special features . . . many were marked "rush". We enjoyed a reputation for accuracy with specifications, promptness on deliveries. But today, because of defense contracts, scarcity of materials and the race against time, our schedule has been broken . . . many times we've been forced to say "no".

★ In the meantime, Viking Representatives in every section of the country stand ready to give advice on the maintenance of Viking Pumps . . . to offer suggestions that will help you receive the utmost in pumping efficiency from the Viking installation you now have. Get in touch with the Viking Office nearest your plant or write direct to the Viking Factory.

We are still able to supply some Viking Pumps from stock. Write for information on models available.

VIKING PUMP CO.
• CEDAR FALLS, IOWA •

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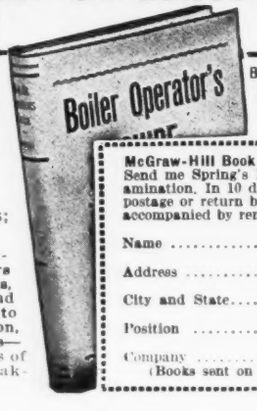
THIS NEW BOILER OPERATOR'S GUIDE
. . . can mean money to you!



JUST OUT! Here's information of the most priceless sort for you — whether you want to improve your ability as an inspector or to utilize effective inspection methods in the more efficient, safer operation and upkeep of your own boilers.

Helps you meet everyday problems; Prepares you for license exams

With hundreds of typical examination questions and answers as well as complete instructions, this book presents fully and plainly the things you want to know about proper installation, operation, and care of boilers—the things that prevent dollars of loss in reduced efficiency, breakdown, or even accident.

By H. M. Spring, Jr. 353 pages, 6 x 9 241 illustrations $3.00

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pressure is checked in the field when the cable is received to assure that no damage has occurred during shipment.

Accessories required for a gas-filled system are joints, terminals, pressure relays, and pressure-regulating equipment are all of simple design. Stop joints are not needed because there is no head pressure with gas-filled cable. However, for the convenience of repair work, runs of more than 40,000 ft can be segregated into sections by incorporating a semi-stop at one end of the normal joint.

Compound-filled terminals are used similar to that used with solid cables except that a cork gasket semi-stop is incorporated in the base. The semi-stop prevents leakage of the petrolatum compound into the cable, but there is enough seepage of gas pressure past the semi-stop to maintain the whole terminal under pressure.

Pressure Relay Alarm

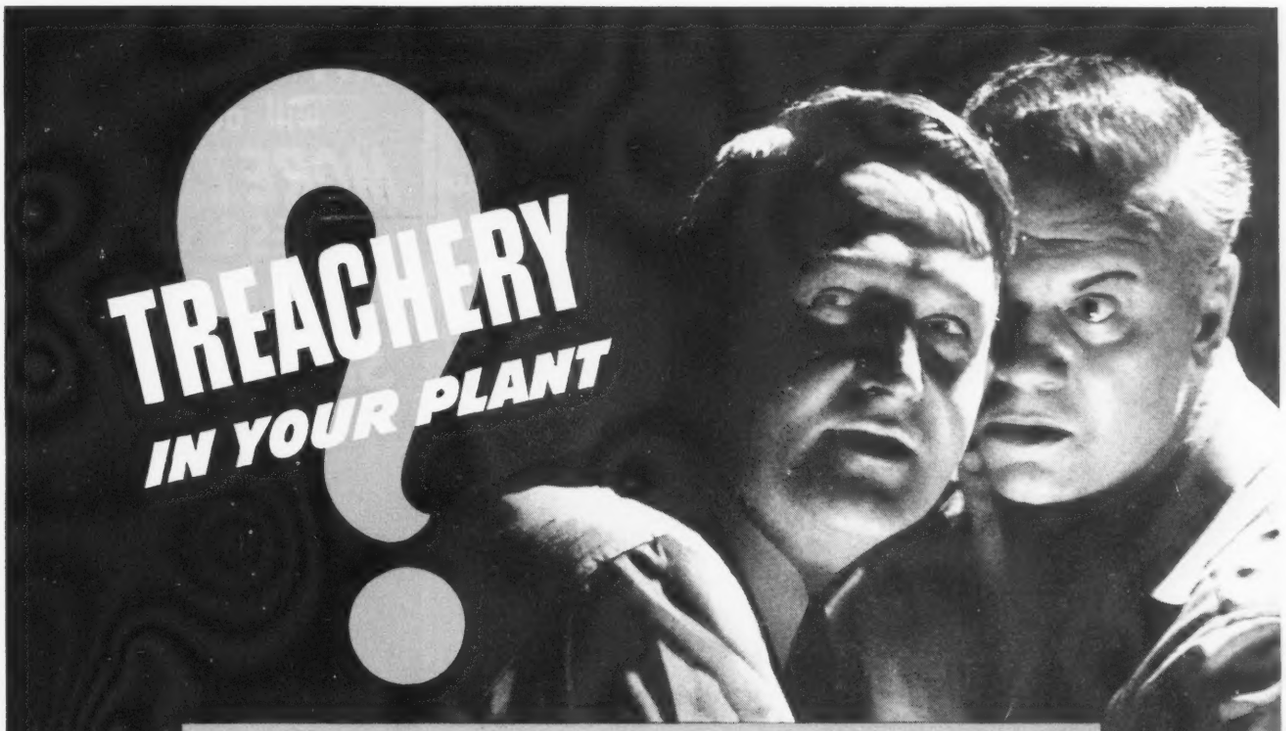
A simple and reliable pressure relay is attached to one or both ends of the line, and gives an alarm if the pressure of gas in the cable drops below 10 lb or rises above 15 lb. Pressure control is maintained manually from the high-pressure gas-storage cylinders normally shut off from the line. Gas volume in the cable is sufficient to take care of daily load-temperature cycles, and readjustment for seasonal ambient temperature is necessary only twice a year. Excessive gas pressure in the cable is brought down by venting.

Mr Sheals said that the first gas-filled cable lines were installed in 1938 on the systems of the Yonkers Electric Light & Power Co, Yonkers, N. Y., and the Consolidated Edison Co, New York City. These were both rated 15 kv and are three-conductor 800,000-cm with 150 miles of insulation. Since that time the latter company has installed additional runs of the cable at both 15 and 27 kv. Last year the Hartford Electric Light Co, Hartford, Conn., installed a 16,000-ft feeder operating at 27 kv to supply power to various defense industries.

GE Names Five New Vice Presidents

Charles E Wilson, president of the General Electric Co, announced Oct. 27 election of five new vice presidents by the board of directors of the company. The new officers are: Walter R G Baker, Chester H Lang, David C Prince, Elmer D Spicer, and Harry A Winne.

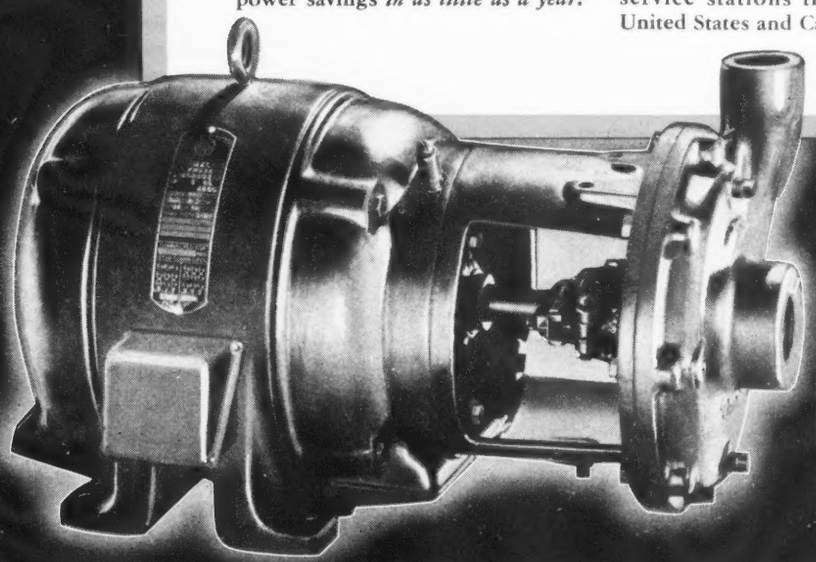
The new officers were elected in con-



PUMPS can be as great a menace to low production costs as human malcontents. Ten-year-old pumps of certain types, for instance, cost *25% more to operate* than those of today's design. In some other types, an age of *only three or four years* means obsolescence that makes continued use more costly than replacement.

Because the penalties of obsolescence are so great, today's far more efficient Fairbanks-Morse Pumps often pay for themselves in power savings *in as little as a year!* And because these improved pumps are superior mechanically too, they *retain* their efficiency longer and so continue to pay dividends in power savings long after their cost has been liquidated.

Perhaps *your* pump operating costs are so excessive that you could replace old pumps with new at a saving. Find out now, without obligation. Write Fairbanks, Morse & Co., Dept. H-66, 600 S. Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.



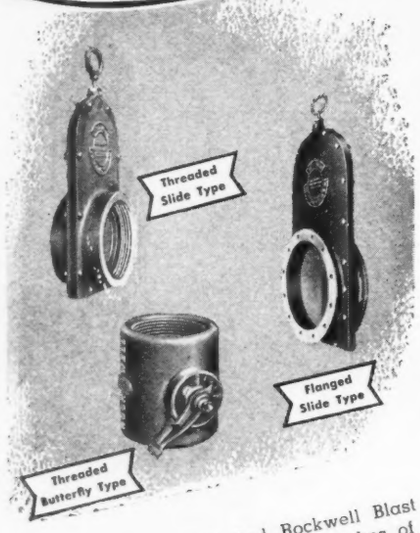
FAIRBANKS-MORSE BUILTOGETHER PUMPS

A complete line of highly efficient, compact, sturdy units consisting of F-M Centrifugal Pumps mounted directly on the shafts of F-M Ball-bearing Motors. No division of responsibility. Easy to install.

FAIRBANKS·MORSE PUMPS

DIESEL ENGINES ELECTRICAL MACHINERY RAILROAD EQUIPMENT WASHERS-IRONERS STOKERS
MOTORS FAIRBANKS SCALES WATER SYSTEMS FARM EQUIPMENT AIR CONDITIONERS

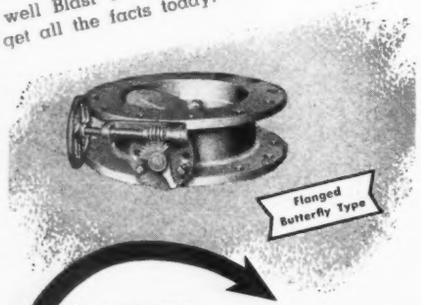
SAVE POWER
STOP LEAKAGE and get BETTER CONTROL of Low Pressure Pipe Lines *with*
ROCKWELL BLAST GATES



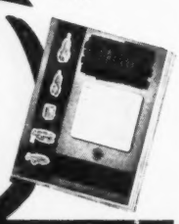
HERE'S why you will find Rockwell Blast Gates on more pipe lines in all branches of industry, than any other kind . . . .

They operate quickly and easily • All Butterfly types have graduated dials for accurate setting and resetting • Carefully machined, with beveled blades that fit air-tight • Gland sealed stems • Full pipe area • Strong, light, durable.

Besides these money-saving features, Rockwell Blast Gates cost less to install. Better get all the facts today.



Catalog No. 4020 makes it easy for you to select the right types and sizes. It's the most complete catalog on Blast Gates available. Send for your copy.



W. S. ROCKWELL CO.
BLAST GATE DIVISION
50 Church St. • New York

nection with a major change in the company's organization. Under the new setup, the company will have four major operating departments: Appliance and Merchandise, under Vice President Hardage L Andrews; Radio and Television, under Vice President Baker; Lamp, under Vice President Joseph E Kewley; and the Apparatus Department which, because of its great volume of business and diversification of products, will be staffed by five vice presidents, whose duties will be along functional lines. These vice presidents are: Mr Lang, in charge of defense activities and also continuing as Manager of Apparatus Sales; Mr Prince, in charge of application engineering—Apparatus Dept; Earl O Shreve, in charge of commercial activities, Apparatus Dept; Mr Spicer, in charge of manufacturing—Apparatus Dept; and Mr Winne, in charge of design engineering—Apparatus Dept.

Vice President William R Burrows, formerly in charge of general manufacturing operations, and Vice President Roy C Muir, formerly in charge of general engineering operations, will become members of the president's staff, carrying out assigned duties in these respective fields.

Massachusetts Engineers' License Law Amended

At a session this year of the Massachusetts legislature, a bill calling for the renewal of all engineers' and firemen's licenses was passed, signed by the governor and became effective November 1, 1941.

This law affects all engineers, firemen and boiler inspectors who hold Massachusetts licenses.

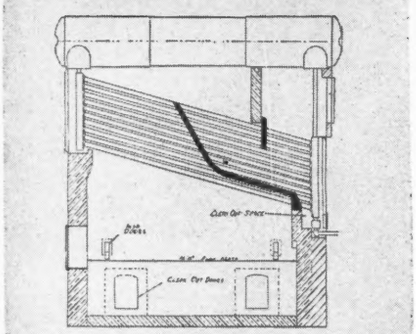
Men who are in military service and are holders of Massachusetts licenses are exempt until a date three months after the date of discharge from the service.

Applications for renewal can be obtained at the office of the Dept of Public Safety, Division of Boiler Inspection, 3 Hancock St, Boston, Mass. Renewal must be made in three months time or stand re-examination.

May Foundation Issues Reports

A new series of reports based on studies of current business management problems was issued recently by the George S May Business Foundation.

ANY type of boiler will deliver MORE POWER at LESS COST with Enco Streamlined BAFFLES

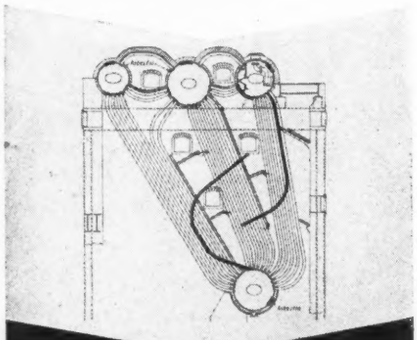


THE cross-flow principle of Enco Streamlined Baffles with its higher efficiencies, may be applied to any type of boiler—horizontal or vertical, straight or bent tube.

By streamlining and curving, gas passages are tapered to maintain velocity as the gas volume is reduced, resulting in a higher rate of heat transfer to boiler and superheater surfaces, and lower flue gas temperatures.

Enco Streamlined Baffles reduce draft loss by eliminating eddy currents, bottlenecks and dead gas pockets—save steam because soot blowers work less often and more effectively.

Ask for Bulletin BW-40 containing valuable engineering data on modern baffle wall construction—It's free.



THE ENGINEER CO.
Enco
75 West St.
New York, N. Y.

WE HAVE TO SPIKE THIS ONE

etc. Commandeering Phosphorous Oxides, with the resulting shortage in all commercial soda phosphates,

PLEASE excuse our bluntness. Here is a situation which in all fairness to ourselves and to the industries we serve we cannot ignore.

An advertiser in a recent issue of POWER made the astounding assertion that owing to defense needs the Government has found it both "necessary" and "unavoidable" to commandeer Phosphorous Oxides, with a resulting shortage in all commercial soda phosphates!

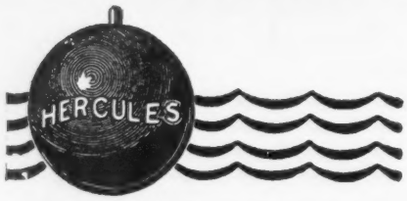
We don't know the source of that advertiser's information, but we do know it is positively not so.

The Government *has not* commandeered Phosphorous Oxides. And as to the suggestion made by this advertiser, namely, that SUBSTITUTIONS ARE THEREFORE IN ORDER, draw your own conclusions.

HAGAN CORPORATION

HALL LABORATORIES, INC. SUBSIDIARY · 300 ROSS STREET · PITTSBURGH, PA.

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

YOUR TOUGHEST DEFENSE against BROKEN FLOORS!

If you want smooth, efficient concrete floors, even under the most punishing traffic conditions . . . make repairs or resurface an entire area with tough RUGGEDWEAR Resurfacer. No chopping or chipping required. Merely sweep out the spot to be patched—mix the material—trowel it on. Holds solid and tight right up to irregular edge of old concrete. Cellulose-Processed to provide a firmer, tougher, smoother, more rugged wearing surface. Used indoors or out. Dries fast. Low in cost.

Valuable 74-page "HAND BOOK OF BUILDING MAINTENANCE" available to those requesting on business letterhead.

MAKE THIS TEST!

FLEXROCK COMPANY
2377 Manning St., Phila., Penna.

Please send me complete RUGGEDWEAR information . . . details of FREE TRIAL OFFER —no obligation.

Name .....
Company .....
Address .....
City ..... State .....

Problems arising from the national defense program receive special attention in several of the studies.

The reports, which are available free of charge to schools, libraries and business executives, cover these topics:

A Study of Supervisory Labor and Its Relation to Profits
A Study of Selective Selling as a Factor in Increased Production
Nine Practical Suggestions for Improving the Output of Power Equipment
A Study of Management Engineering Service as an Aid to Bank Clients
Thirteen Suggestions for Increasing the Output of Skilled Labor
A Study of the Persistence Factor in Advertising
A Survey of the Current Training Effort for Defense Jobs
Some Suggestions for Turning Wastes into Profits
How to Introduce Incentive Rates

Compressed Air Institute Announces Prize Contest

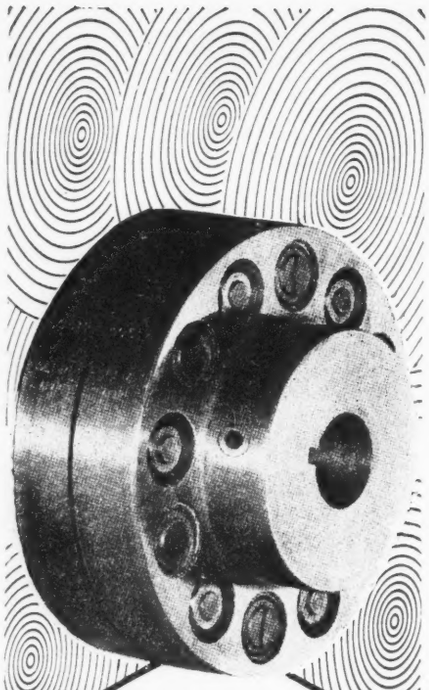
The Compressed Air Institute announces a nation-wide contest for industry, which started December 1, 1941. The contest is to continue for six months, closing June 1, 1942. Fourteen cash awards will be given. These comprise a first prize of $100; three $50 prizes and ten of $25, and as many additional awards of $25 as there shall be contestants who submit material acceptable for use in technical journals.

Articles submitted are to be judged according to the usefulness to the industry of the idea submitted; the originality of the text; the value of the text to the greatest number of industries and the technical completeness with which the subject is treated.

Subject matter may deal with anything of particular interest to the compressed air industry. Any process using compressed air alone or in combination with other power will be suitable material on which to base an article for the contest. Any entry which is particularly adaptable to defense work and the speeding up of the Defense Program, whether a prize winner or not, will be brought to the attention of the proper Government agency, with credit given contestant.

The contest is open to any employee of any organization using or associated with compressed air in any department.

All contest presentations to be mailed to C C Rohrbach, Secretary, Compressed Air Institute, 90 West Street, New York.



Keep the wheels turning with

AJAX

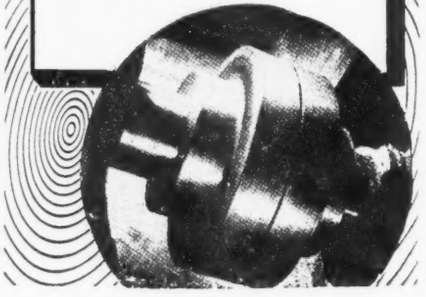
FLEXIBLE COUPLINGS

This is no time for shutdowns! Safeguard your production with Ajax Flexible Couplings! Their exclusive, rubber bushed, bronze bearings combine positive drive, resilient protection against misalignment, free end float, no lubrication problem, no noise, no backlash. Sizes from ½ inch bore up. Write for catalog.

Sales Offices in all principal cities . . . Look for Ajax in your phone book.

AJAX
FLEXIBLE COUPLING CO.
132 English St., Westfield, N.Y.

All the horsepower goes through this Ajax Coupling in the main power drive of a large flour mill as shown below.



ALLOYS

Timely information about metals...
CATALOGUED for your convenience

Specific answers to many of your questions about the selection, fabrication and uses of Nickel alloys are available to you quickly from our files.

This fund of helpful information we have gathered, checked and condensed into convenient printed form. The graphs, charts and shop guides are especially useful to men handling new materials or performing unfamiliar operations . . . and to new employees. This literature is available on request.

You are also offered the assistance of our technical staff in solving material problems arising from a temporary lack of Nickel. These engineers are offering timely suggestions to many vital industries during the present emergency.

Why not drop us a card asking for list of available literature. Your request for the assistance will receive prompt attention.

NICKEL

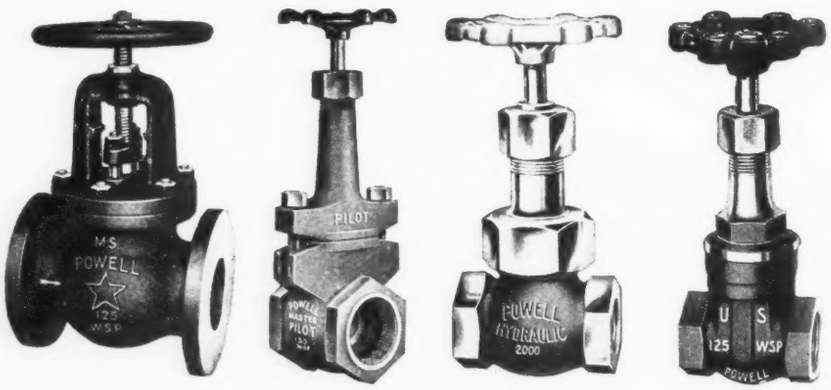
THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

POWELL HAS

From the smallest needle valve in the instrument line to the largest motor driven, high-pressure valve, it's Powell all the way. Every need in the power field has been met and satisfied by Powell research and engineering.

Shown here are a few samples of the many Powell Valves which have been made-to-order to suit some particular requirement and, having completely fulfilled it, have taken their places in the Powell line. There are many, many others in the line and there will be many more

POWELL



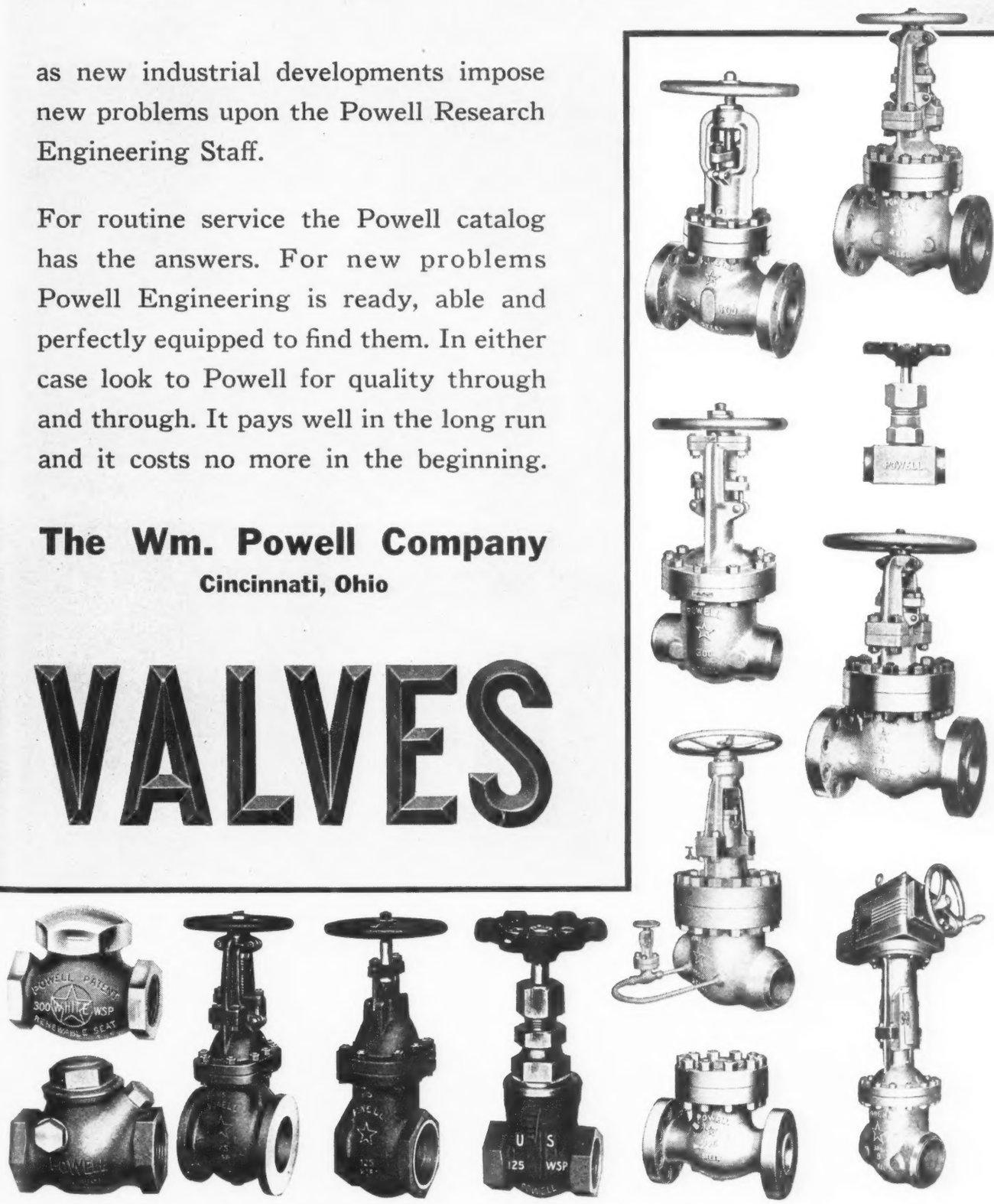
THEM ALL...

as new industrial developments impose new problems upon the Powell Research Engineering Staff.

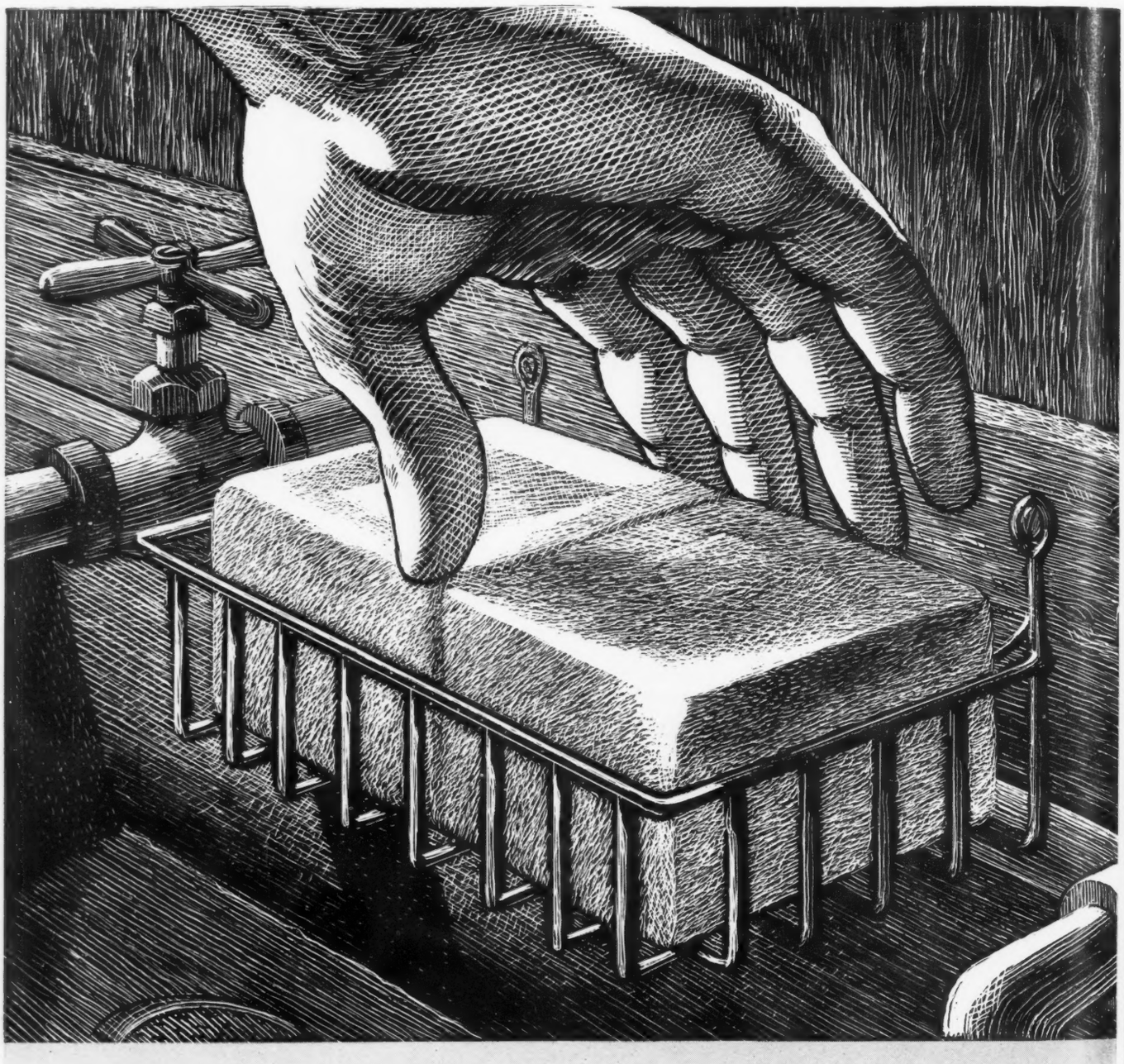
For routine service the Powell catalog has the answers. For new problems Powell Engineering is ready, able and perfectly equipped to find them. In either case look to Powell for quality through and through. It pays well in the long run and it costs no more in the beginning.

The Wm. Powell Company
Cincinnati, Ohio

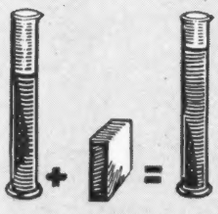
VALVES



ANTI-FRICTION BEARINGS . . . .



Just as a sponge controls the water it has absorbed, so is soap a thickening agent which controls the flow of the lubricant to the bearings.



Maximum economical lubrication per pound of grease is assured by the use of cylinder oil, making a minimum of soap necessary.

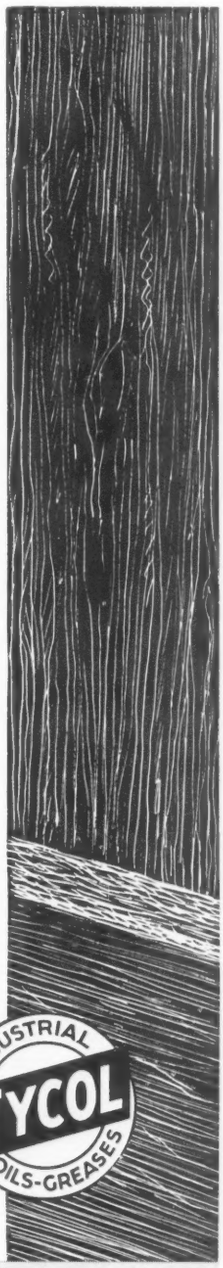
ARE NO LONGER "SOAP DISHES"

after changing to TYCOL GREASES

Anti-friction bearings were so caked with soap deposits from easily broken down grease that they could pass for "soap dishes." This accumulation of old, hard, soapy grease prevented the entrance of new lubricant, caused costly damage to the roller bearings from lack of proper lubrication. But the bearing "soap dish" era has gone and bearing worries are ended now that this steel mill is using Tycol Grease.

Why do Tycol Greases stand up in tough lubricating jobs where other greases soon run out or separate to form hard soap deposits? It's because Tycol Greases are made from the highest quality lubricating oils combined with a minimum of soap for a given consistency. Tycol Grease is water repellent, "stays put" indoors and out.

A Tide Water engineer will gladly help you maintain maximum production through proper lubrication. Full details may be obtained by writing the Tide Water Associated Oil Company, 17 Battery Place, New York, N. Y.



Regional Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

TIDE WATER ASSOCIATED OIL COMPANY

EASTERN DIVISION

17 Battery Place • New York, N. Y.

DRUMS, DRUMS, DRUMS!
Defense needs make it extremely important that all empty drums be returned immediately.

Veedol Motor Oil is another well-known product of the Tide Water Associated Oil Company

INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER GREASES

Tycol Green Cast Greases are made of paraffine stock cylinder oil which has high flash and fire points, with maximum film strength.

REVERE copper and

FOR POWER SERVICE

CONDENSER TUBES

Revere condenser and heat exchanger tubes are available in a number of alloys with a comprehensive range of characteristics which adequately meet the requirements of industry. In general, the development of special alloy tubes has been made with the intention of supplying alloys, which because of their composition, are not subject to dezincification and which, in addition, have tough, tenacious protective films which give them a high resistance to erosion and impingement attack.

Revere produces its tubes by improved manufacturing methods that provide tubes of unusual mechanical soundness and surface perfection. Revere tubes are available from ⅝" to 2" O.D., with wall thicknesses from No. 8 to No. 19 Stubs Gauge.

70-30 Cupro-Nickel. Containing no zinc, Revere tubes of this alloy are not subject to dezincification. In addition they develop an especially tenacious surface film, highly resistant to impingement attack and erosion. 70-30 Cupro-Nickel tubes are generally recognized as the finest condenser tubes available for severe conditions. Where conditions are less severe, 80-20 Cupro-Nickel may be used with economy.

Admiralty. Condenser tubes of Admiralty Metal have long been considered standard. The mechanical excellence of Revere tubes makes Admiralty a sound specification in perhaps the majority of installations. Revere has now standardized on the inclusion of .03% of arsenic in all Admiralty tubes to inhibit dezincification.

Red-Brass. An alloy of 85% copper and 15% zinc. Revere Red-Brass has excellent corrosion resistance to a variety of water conditions, and is practically immune to dezincification. It is recommended for general piping purposes as giving excellent service at a moderate cost.

Arsenical Copper. 99.7% copper, 0.3% arsenic. Arsenical Copper with .30% arsenic content, is suitable for fresh water service where corrosive conditions are mild. It has also given satisfactory service in many installations where Muntz Metal and Admiralty were previously used. It has a higher thermal conductivity than either Admiralty or Muntz Metal and is more resistant to scaling under conditions of high temperature operation.

Muntz Metal. 60% copper, 40% zinc. Muntz Metal tubes are satisfactory in fresh water steam power plant installations where the corrosion problem is mild. While the extrusion process is generally used by Revere in connection with the production of condenser and other engineering tubes, Muntz Metal tubes are manufactured by the Mannesman process.

TUBE SHEETS

Revere plates are produced by rolling, under extremely close technical control, insuring sound metal with a dense structure free from blow holes and surface imperfections. Furnished principally in Muntz Metal and Naval Brass, they can also be supplied in other alloys for special applications. They are available in the form of squares, rectangles, circles, half-circles, segments and irregular patterns.

COPPER WATER TUBE

Because Revere Copper Tube is non-rusting, it is not necessary to install oversize lines to allow for accumulation of rust. The gun-barrel finish of Revere Tubes cuts down friction and facilitates the rapid passage of liquids, air or gas. Joined with soldered or compression fittings, Revere Copper Tube forms a superior installation at reason-

REVERE COPPER AND BRASS INCORPORATED

Sales Offices and Distributors in most of America's major cities · MILLS: BALTIMORE, MD. · TAUNTON, MASS. · ROME, N. Y.

copper alloys

able cost. It is available in four types for different services ranging from general plumbing to various process applications.

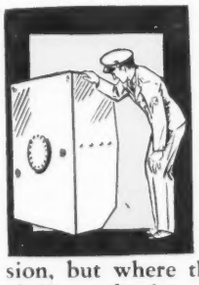
BRASS AND COPPER PIPE

Revere produces Red-Brass as well as 99.9% pure copper pipe in standard pipe sizes. The Revere Technical Advisory Service will gladly help to determine the most economical and dependable type of pipe for your purposes.

BUS BAR

Revere high-conductivity Copper Bus Bar is uniform in section and mechanically sound. It is supplied in tubular, rectangular, and specially drawn or extruded shapes.

HERCULOY



Herculoy is Revere's patented silicon bronze alloy which combines corrosion resistance similar to that of pure copper with strength equivalent to that of low and medium carbon steel. It is particularly recommended in applications where copper would present adequate resistance to corrosion, but where the high strength, ready weldability and other physical characteristics of Herculoy render it valuable as a structural material. Tanks, bolts, nuts, turnbuckles, lag screws, screw machine parts and accessories are some of the applications in which the great strength and corrosion resistance of Herculoy can offer particular advantages.

Free—Write for Revere's 3 booklets on Copper and Copper Alloys For Power Plants . . . For The Mechanical Industries . . . For The Process Industries.

Executive Offices: 230 Park Avenue, New York

NEW BEDFORD, MASS. • DETROIT, MICH. • CHICAGO, ILL.

REVERE TECHNICAL ADVISORY SERVICE

In many plants and industries, Revere Technical Advisory Service men are working shoulder to shoulder with executives and engineers in solving defense problems by selecting a suitable type and form of copper or one of the many copper base alloys.

These are picked men, with broad backgrounds in metalworking methods, plus highly specialized knowledge of copper and copper base alloy characteristics and applications. They are supported in this work by the full cooperation of the Revere Research Laboratories and Revere Mills.

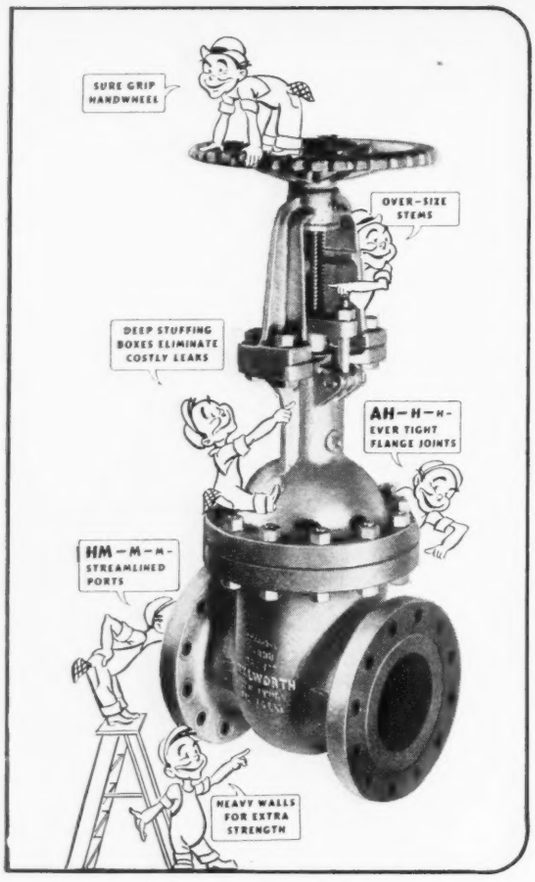
This Technical Advisory Service comprises a thoroughly equipped Research Laboratory, manned by engineers and metallurgists for (1) developing new and better Revere materials to meet active or anticipated needs of industry; (2) supplying specific and detailed knowledge of the properties of engineering and construction materials; and (3) continuously observing developments of science and engineering with a view to their utilization in the improvement of Revere production methods and equipment.

In addition a corps of technical men are available to (1) help industrial executives make use of data developed by the Revere research laboratory staff; (2) perceive the material problems existent in industrial plants contacted; (3) assemble data enabling Revere research laboratory men to study these problems; and (4) make practical tests of the materials recommended in the plants concerned.

This Revere Technical Advisory Service set-up has been very successful in reducing costs, improving products and increasing the output for many industrial concerns.

Its service is available to you with no expense or obligation on your part.

WHATEVER THE SERVICE—*you need*


SURE GRIP HANDWHEEL
OVER-SIZE STEMS
DEEP STUFFING BOXES ELIMINATE COSTLY LEAKS
AH—H—H— EVER TIGHT FLANGE JOINTS
HM—M—M— STREAMLINED PORTS
HEAVY WALLS FOR EXTRA STRENGTH

STEEL VALVES...for Steam, Oil, Water or Gas

Walworth manufactures a complete line of cast steel valves in gate and globe types, built to give trouble-free service on the toughest of jobs.

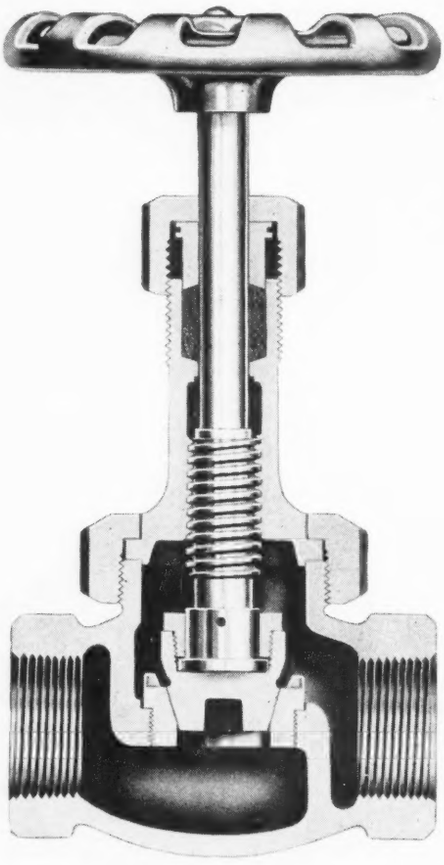
Walworth Steel Valves have heavy walls for extra strength and protection. Deep stuffing boxes eliminate costly leaks. The flow loss at high velocity is considerably decreased by streamlined ports. Every detail of design, metallurgy, and construction helps obtain better service for a longer period of time.

BRONZE VALVES...for General Use

To meet the varied requirements of industry for Bronze Valves, Walworth has developed complete lines in the Gate, Globe, Angle, Cross, and Check types for all pressures and services for which Bronze Valves are suitable.

Outstanding, is Walworth No. 218P Globe Valve shown in cross section at the right. This valve has a stainless steel, plug type, seat and disc, heat treated to a minimum of 500 Brinell hardness. Boiler scale, sand, grit, and other foreign particles cannot mar the surface of either the seat or disc, and therefore wire-drawing is practically eliminated. Extra large stems and long stem threads have been provided to decrease thread wear and increase valve life. Every part has been designed to assure maximum protection against wear and leakage. For angle type, specify Walworth No. 219P.

These valves are available in sizes from ¼-inch to 2-inches and are recommended for general service on steam, air, oil, water, or gas up to 300 psi at 550° F.



No. 218P Bronze Globe Valve with 500 Brinell seat and disc.

WALWORTH

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

VALVES FITTINGS and TOOLS
Backed by 99 Years' Service

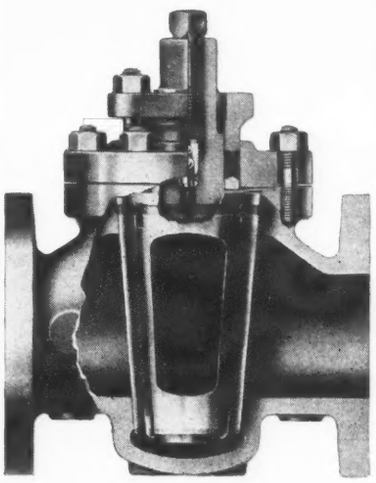
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH VALVES *and* FITTINGS

LUBRICATED PLUG VALVES... for Oil, Water, Gases, Gasoline, Chemicals, Acids, Solvents, etc.

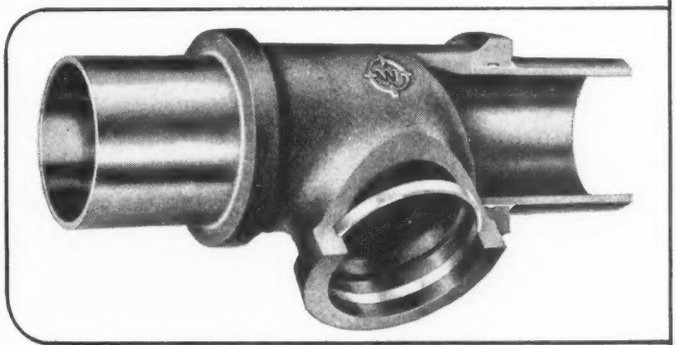
Some fluids are difficult to control with conventional types of valves – but Walworth Lubricated Plug Valves do the job safely and easily. They may be opened or closed with but a quarter turn of the handle, and have proved their ability to give a dead-tight shut-off. Operation is sure and smooth because of Walworth's 4-point lubrication.

All these qualities plus greater protection against corrosion and erosion make Walworth Lubricated Plug Valves ideal for "difficult" jobs. They are made in sizes from ½ to 24-inches and for pressures from 125 to 5,000 pounds.



WALSEAL FITTINGS...for making SILBRAZ JOINTS in copper or brass lines

WALSEAL FITTINGS are threadless bronze fittings into the ports of which the correct amount of silver brazing alloy has been inserted by Walworth at the time of manufacture. Joints are made by inserting the pipe end into the fitting port, and heating both pipe and fitting with an oxyacetylene flame. The resulting joint is a SILBRAZ JOINT and is silver-brazed – not soft soldered. Bronze valves with WALSEAL ends instead of threaded ends are also available.



SILBRAZ JOINTS save time and effort. A brass or copper line made up with WALSEAL VALVES and FITTINGS is actually a "one-piece" line having a copper content of more than 80 percent. It is leak-proof, vibration-proof, and corrosion-resistant.

WALWORTH'S COMPLETE LINE *includes:*

★

BRONZE VALVES AND COCKS
all types and pressures

★

IRON BODY VALVES AND COCKS
all types and pressures

★

STEEL VALVES
all types and trimmings. Pressures: 150–1500 lbs. Steam. Oil, Water & Gas up to 5000 lbs.

★

LUBRICATED PLUG VALVES
all metals and pressures

★

BRONZE FITTINGS
screwed and flanged

★

CAST IRON FITTINGS
screwed and flanged

★

MALLEABLE IRON FITTINGS
screwed

★

STEEL FITTINGS
screwed and flanged

★

CAST IRON THREADED PIPE
Hi-Test, C.N.I., Ni-Resist

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SOIL PIPE AND FITTINGS

★

DRIVE WELL POINTS
Foot valves, etc.

★

PIPE WRENCHES
Genuine Stillson, Walco Parmelee

★

WALSEAL
bronze valves and fittings for making Silbraz joints

★

Write for Full Information

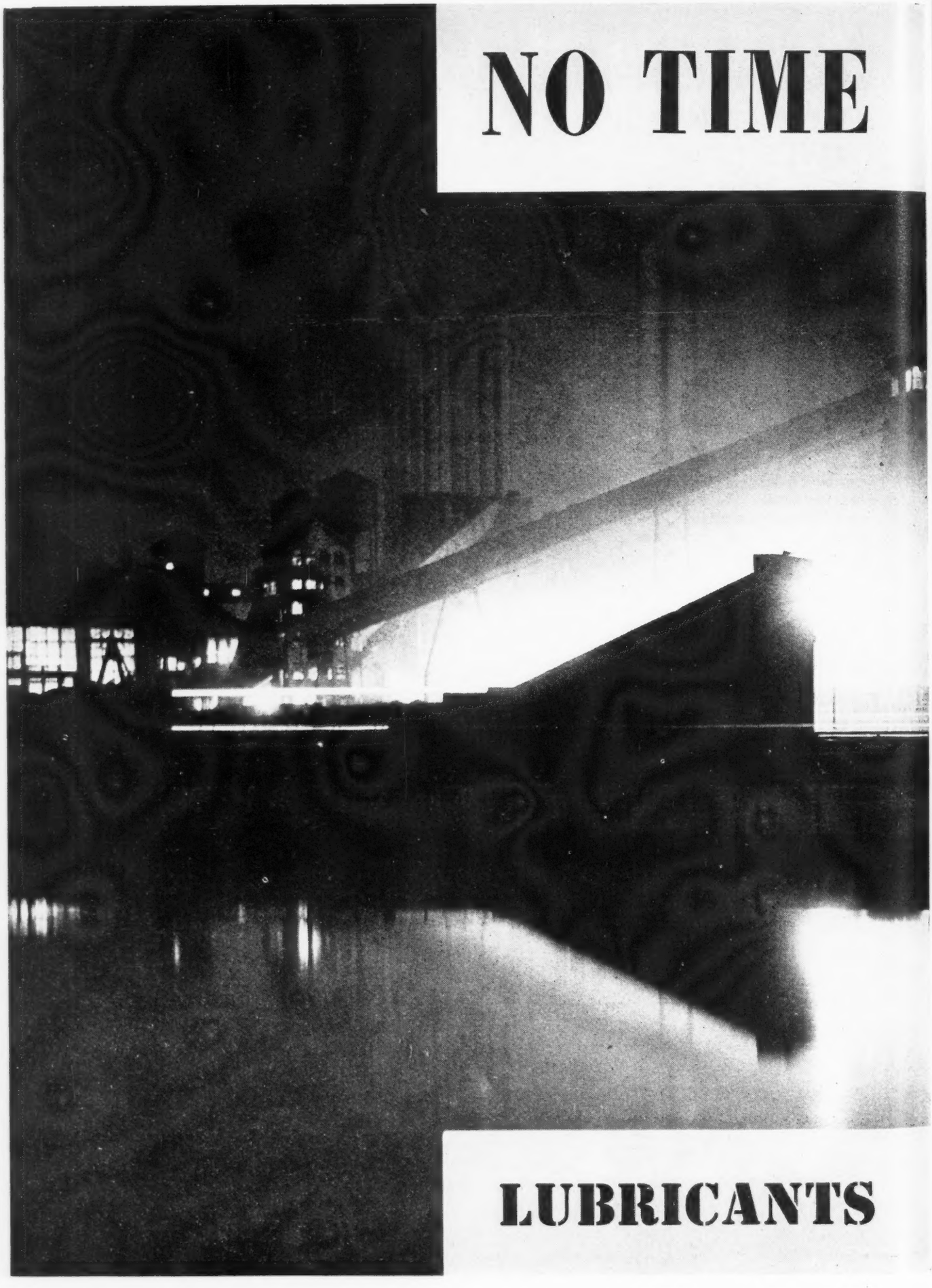
WALWORTH

WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

VALVES FITTINGS and TOOLS
Backed by 99 Years' Service

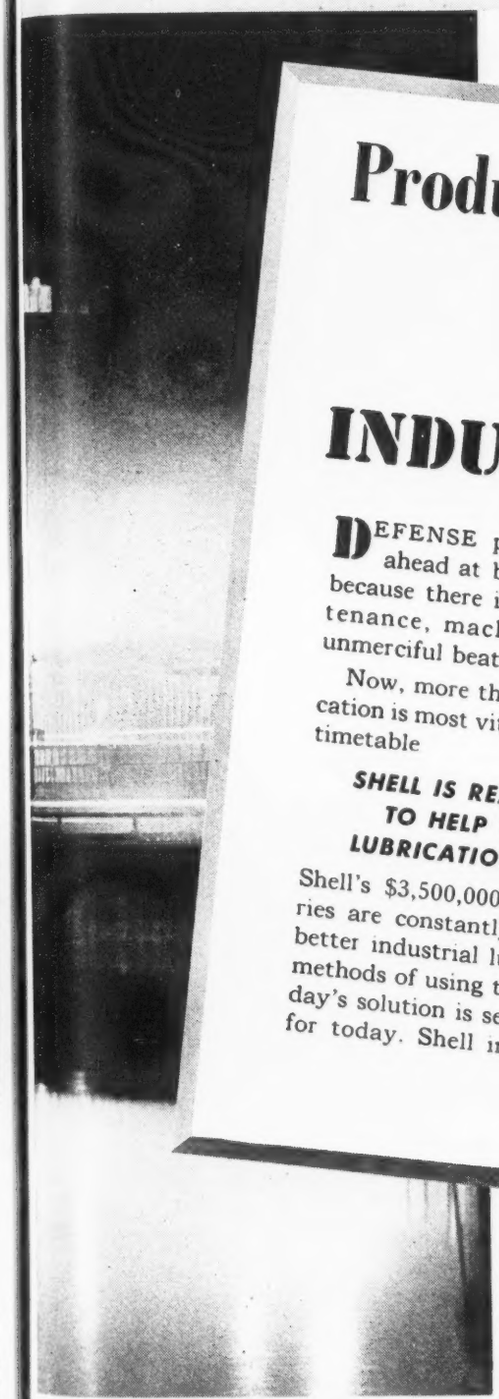
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

NO TIME



LUBRICANTS

FOR "TIME OUT"—



Production keeps humming with SHELL INDUSTRIAL LUBRICANTS

DEFENSE production is driving ahead at breakneck speed . . . and because there is little time for maintenance, machines are taking an unmerciful beating.

Now, more than ever, proper lubrication is most vital to your production timetable

SHELL IS READY AND ABLE TO HELP WITH YOUR LUBRICATION DIFFICULTIES

Shell's $3,500,000 research laboratories are constantly at work creating better industrial lubricants . . . better methods of using them . . . for yesterday's solution is seldom good enough for today. Shell industrial oils and greases are being used by every type industry . . . to eliminate bottlenecks . . . increase production . . . lower costs And because there is no time to experiment, you'll appreciate Shell's industrial lubricants being plant-tested . . . proved . . . under actual operating conditions.

Is your plant getting the benefit of all that is new in industrial lubrication, as it develops? Have a Shell man check over your lubrication setup and be sure You'll find his recommendations entirely practical—and made without obligation. And with the use of Shell lubricants you are assured of the continued watchfulness of Shell men—a service that needs no prompting.

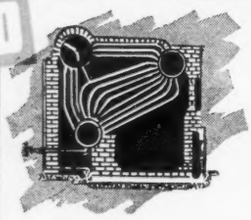
SHELL

FOR EVERY INDUSTRIAL USE

STILL MORE IMPRESSIVE TODAY!

6 VERY IMPRESSIVE FACTS

12,614,000 lb. per hr.



Steam Generated

690,000

K.W. per hr.
(High Pressure Units Only)
Capacity

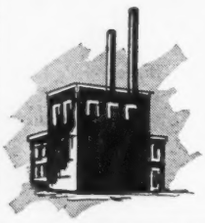
900°F. to 950°F.

Temperature Conditions

1240 to 2200 lb.

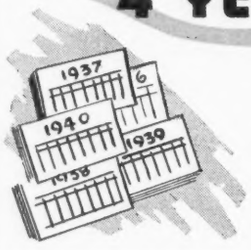
Pressure Range

13 CONTRACTS



Awarded

4 YEARS



1936 to 1940

The Figures given above show the confidence placed by consulting engineers, central station and industrial plant engineers and operators in this organization's ability to design, prefabricate and erect piping, regardless of the size of the job. The Kellogg Company has also prefabricated and erected many piping jobs ranging from 200 pounds pressure up.

Call in this organization the next time you have a piping project.

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Dec. 19

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"Masterflex" Prefabricated Piping Systems · "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units · JUIK Processes for Lubricating Oil Plants. Plastic Refractories · Radial Brick Chimneys.

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TUBE CLEANERS — Air, Steam or Water Driven — for Boilers, Condensers, Evaporators, Cracking Coils, Stills and other Heat Exchangers, give you More Power—Faster Cleaning—One-man Operation

For Small Tubes

Model 130 air-driven motor with swing-frame head for straight tubes
Model 20 water-driven motor with combination drill head
Model 135 air-driven motor with vibrating head for fire tubes
Swing-frame head for straight tubes
Large wire brush
Model 110 air-driven motor with 6-way drill head
Short 3-arm head
Combination drill with replaceable wearing parts
Model 130 air-driven motor for curved tubes, with air-valve and swing-frame head
Model 71 air-driven motor with drill head
Model 23 water-driven motor with pivot head
Model 39 air-driven motor with pivot head and air valve
Sectional wire brush and replaceable section
Universal joint and drill head
Floating cutter head
Model 105 air-driven motor with 2-arm head and air valve
Model 33 Junior motor with cone cutter head
Model 34 Junior motor with wire-flexible coupling, expanding scraper head and replaceable blade
Expanding brush and replaceable section
Complete parts of Model 33 Junior motor, showing simplicity in design

Let us help you with your tube cleaner problem

The ROTO Company

Tube Cleaner Specialists Since 1910

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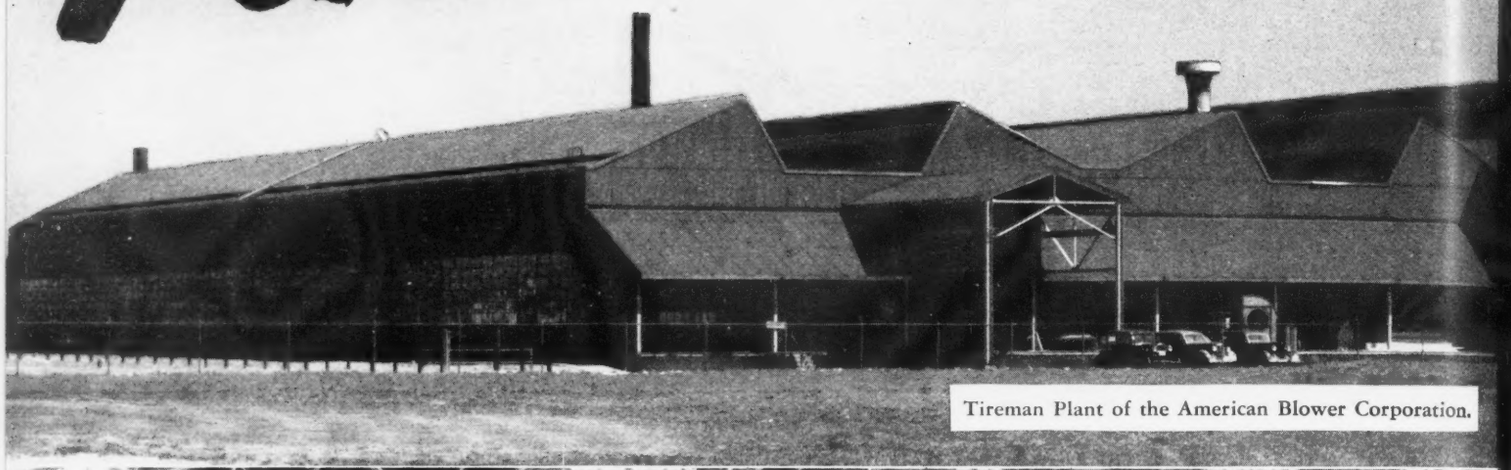
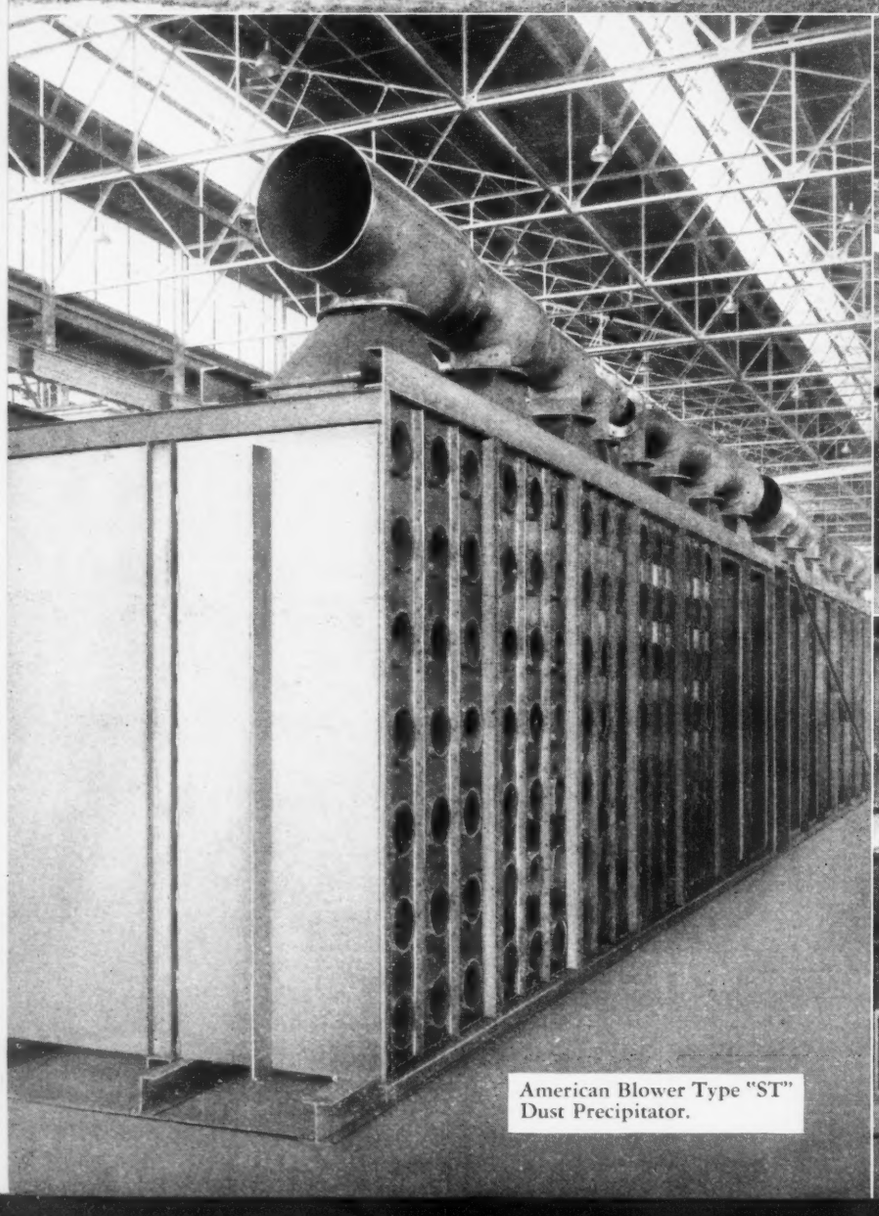
Send for bulletin covering your specific requirement

American Blower is going

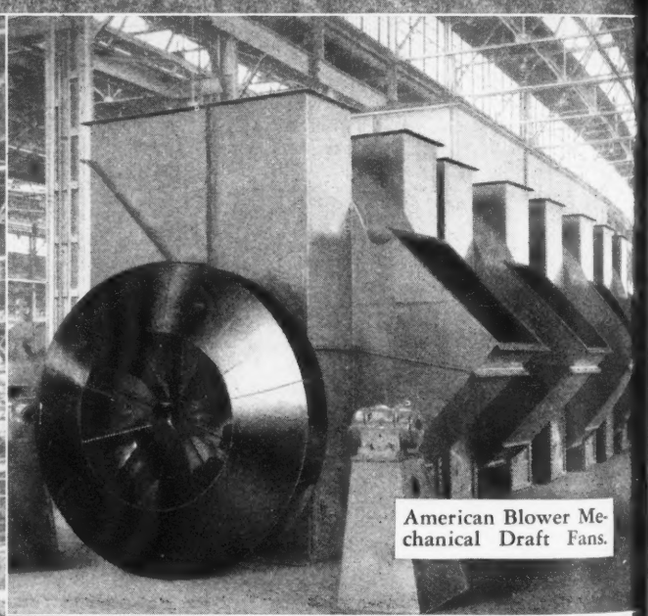
FULL SPEED



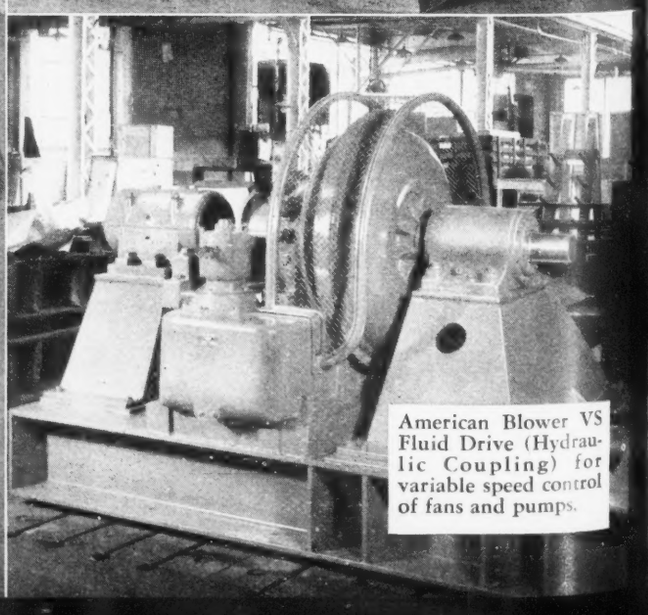
Tireman Plant of the American Blower Corporation.



American Blower Type "ST" Dust Precipitator.



American Blower Mechanical Draft Fans.



American Blower VS Fluid Drive (Hydraulic Coupling) for variable speed control of fans and pumps.

Producing Mechanical Draft Fans – Dust Precipitators and Fluid Drives for National Defense

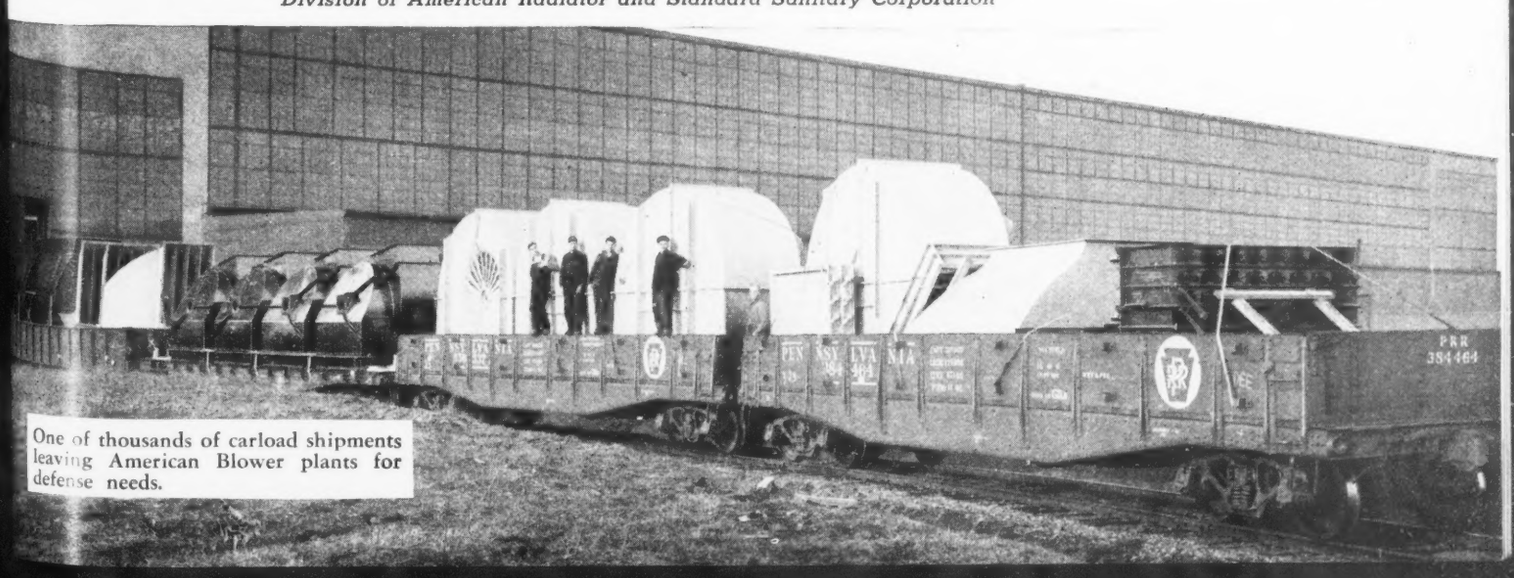
In American Blower's modern plants, you'll find production of Forced and Induced Draft Fans, Dust Precipitators and Fluid Drives (Hydraulic Couplings) for power plants going "full speed ahead." We regard this as one of the most essential parts of our defense activity, because abundant, dependable electric power is vital to every phase of national defense.

America's power producers' readiness to meet today's heavy demands is evidence of foresighted, sound management policies. And we pledge the best efforts of our entire organization in the production of more and more Mechanical Draft, Dust Precipitator and Fluid Drive Equipment so necessary to the rapid expansion of the facilities necessary to meet defense needs.

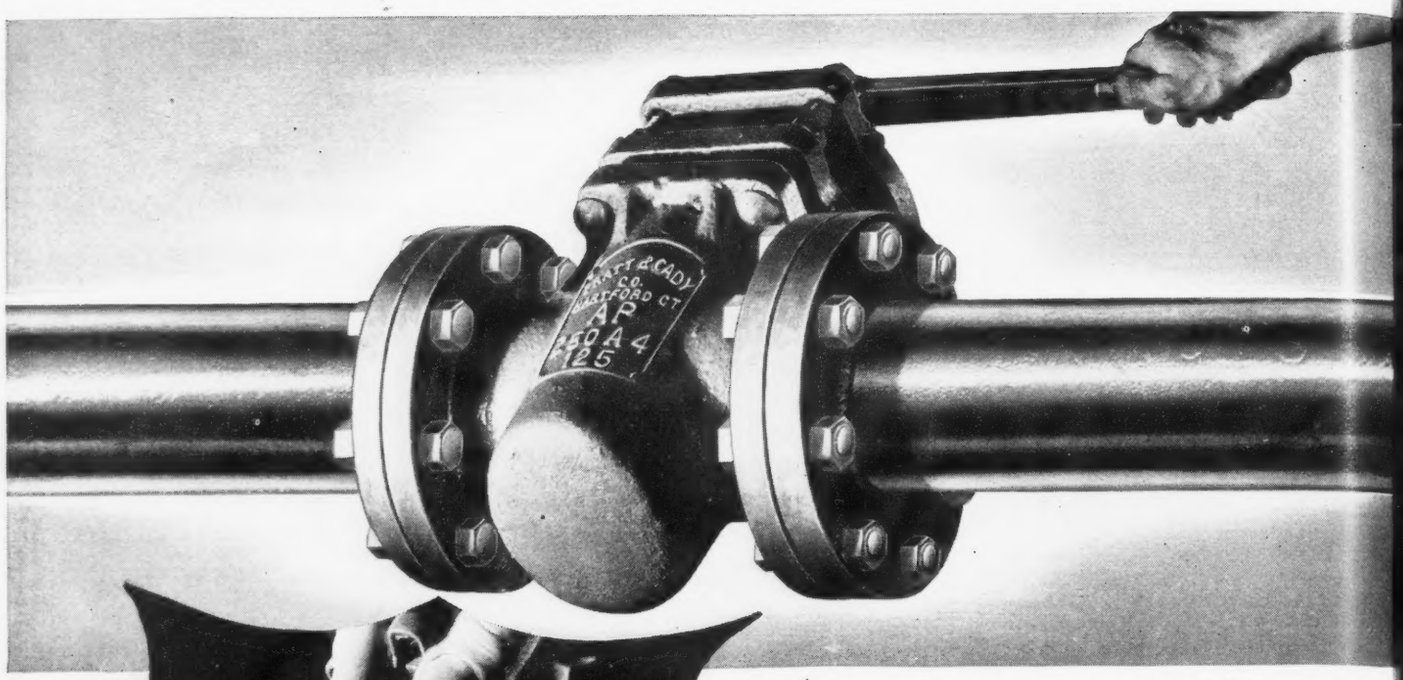
AMERICAN BLOWER

AMERICAN BLOWER CORP., 6000 Russell St., Detroit, Mich. • CANADIAN SIROCCO CO., LTD., Windsor, Ontario

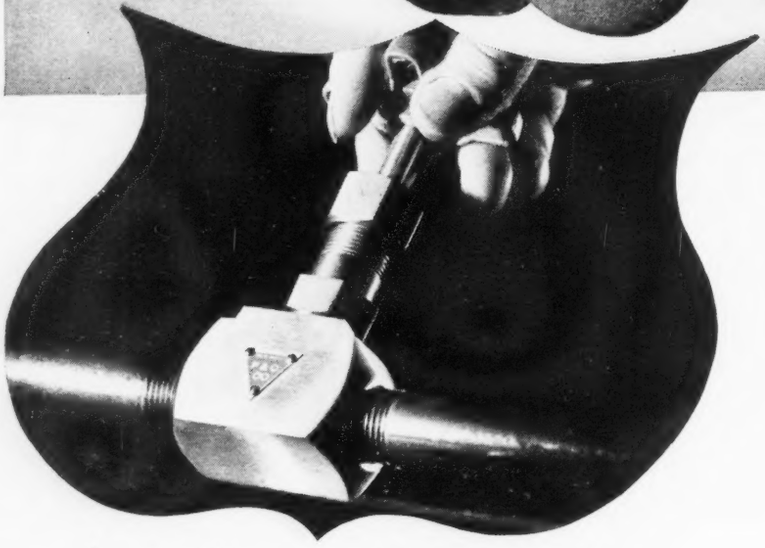
Division of American Radiator and Standard Sanitary Corporation



One of thousands of carload shipments leaving American Blower plants for defense needs.



Asbestos Packed Cocks. Originated by Reading-Pratt & Cady. Even when used infrequently, turns with a fraction of the effort required to operate a ground cock—yet holds constant, tight seal.



Bar Stock Valves. Originated by Reading-Pratt & Cady. Diameters up to 1". Turned on precision set machines from Bar Stocks of various metals. For close control under severe throttling conditions.

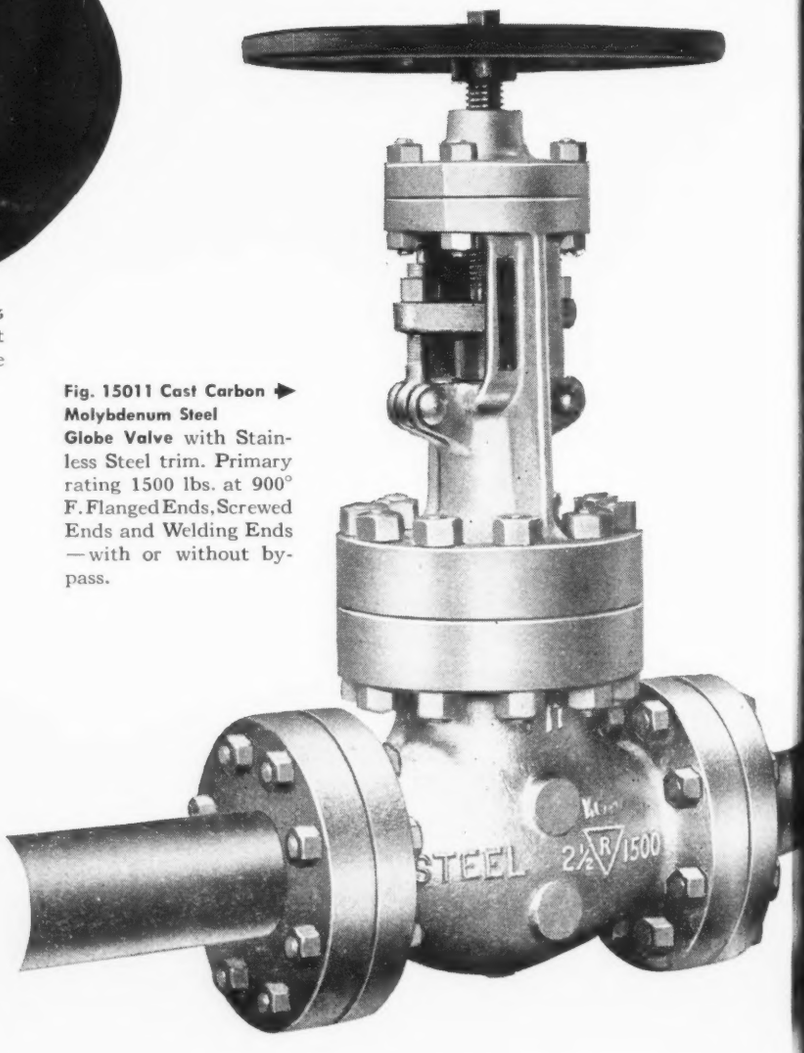


Fig. 15011 Cast Carbon Molybdenum Steel Globe Valve with Stainless Steel trim. Primary rating 1500 lbs. at 900° F. Flanged Ends, Screwed Ends and Welding Ends—with or without by-pass.

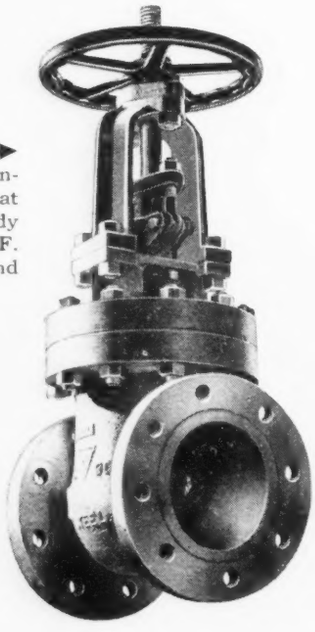
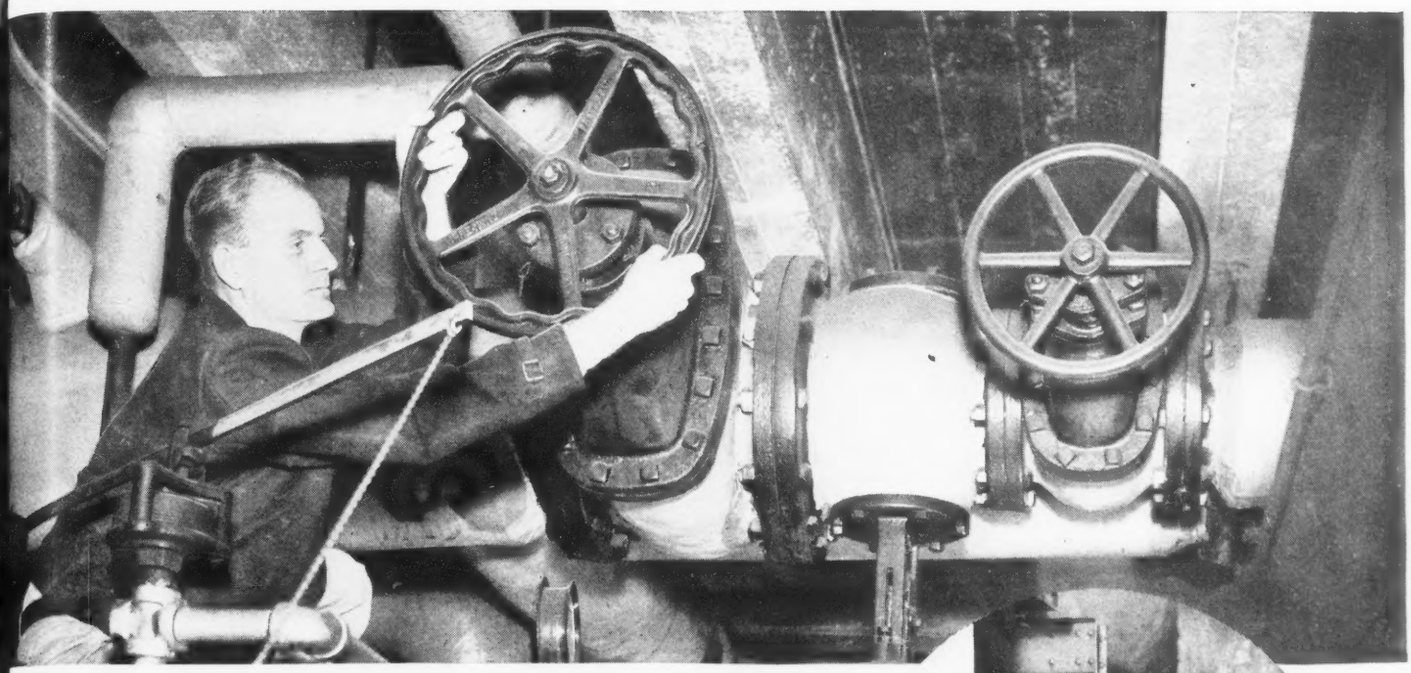


Fig. 3001 Cast Carbon Steel Gate Valve. Stainless Trim. 300 lbs. at 750° F. Alloy steel body for 300 lbs. at 900° F. Flanged, screwed and welding ends.



Reading-Pratt & Cady Gate Valve on the Main Steam Header of a low pressure heating system.

MATERIALS are scarce! Conserve them by installing valves which under the gaff of twenty-four-hour operation do not require early replacement and the repeated use of critical materials.

Before buying new valves, take advantage of renewable features. Replace worn parts and continue to use the critical metals in parts still serviceable.

Valves are vital to defense. Our capacity, now fully absorbed by defense work, has been increased and further increase made possible by the recent consolidation of our facilities at Reading, Pa. While scarcity of materials slows the outward flow of production, our position is now much stronger than before the consolidation.

READING — CAST STEEL VALVES AND FITTINGS
PRATT & CADY — BRASS AND IRON VALVES
D'ESTE — VALVE AND ENGINEERING SPECIALTIES

In Business for Your Safety

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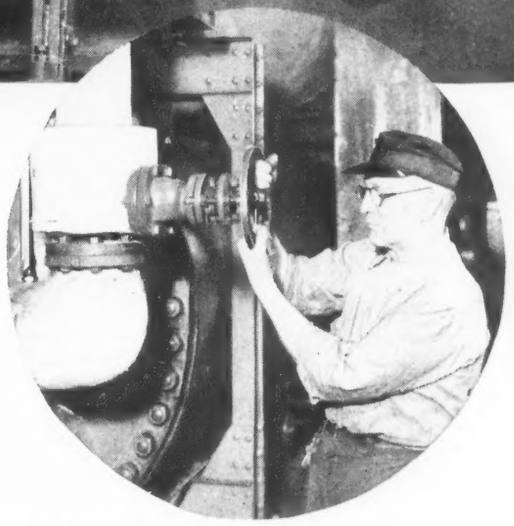
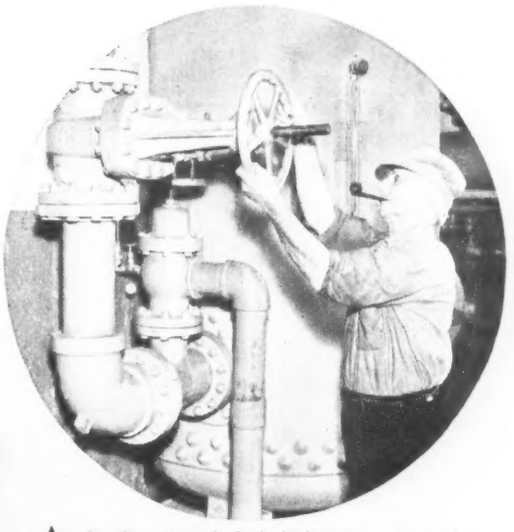
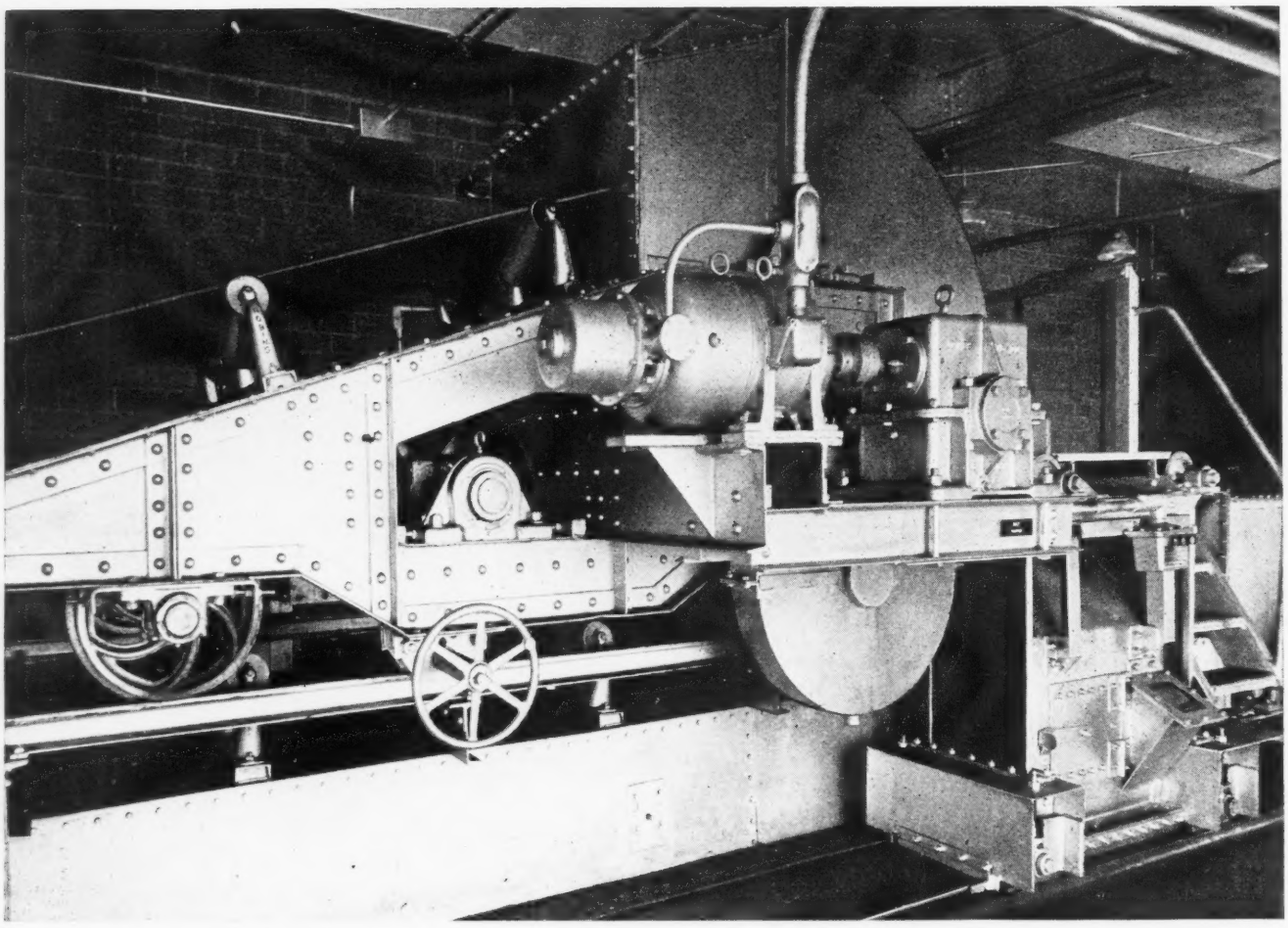


Reading-Pratt & Cady Valve on the condenser system of a large plant in Kansas City.

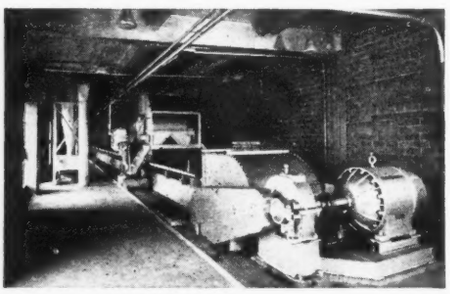


Reading-Pratt & Cady Valve on automatic high pressure fire protection system in a large building.

A Division of AMERICAN CHAIN & CABLE COMPANY, INC.



THIS TRIPPER KEEPS IT CLEAN



The unique design of this Robins motor-driven Bunker House Distributing Tripper practically eliminates dust nuisance and hazard. The coal entering the tripper chute passes through a slotted rubber curtain. From then on the coal is confined within the enclosed chute until it is discharged into the bunkers. The opening slot over the bunkers is completely covered by a sealing belt except for that portion where the tripper chute is feeding the bunker. The installation shown is in one of the most modern central stations in the middle west. Full information will be gladly sent upon request.

Robins Makes Belt Conveyors, Screens, Screen Cloth, Bucket Elevators, Feeders, Weigh Larries, Bin Gates, Trippers, Grab Buckets, Car and Barge Hauls, Unloading Towers and Skip Hoists for large and small plants. Write to us for bulletins and information about products of interest to you.

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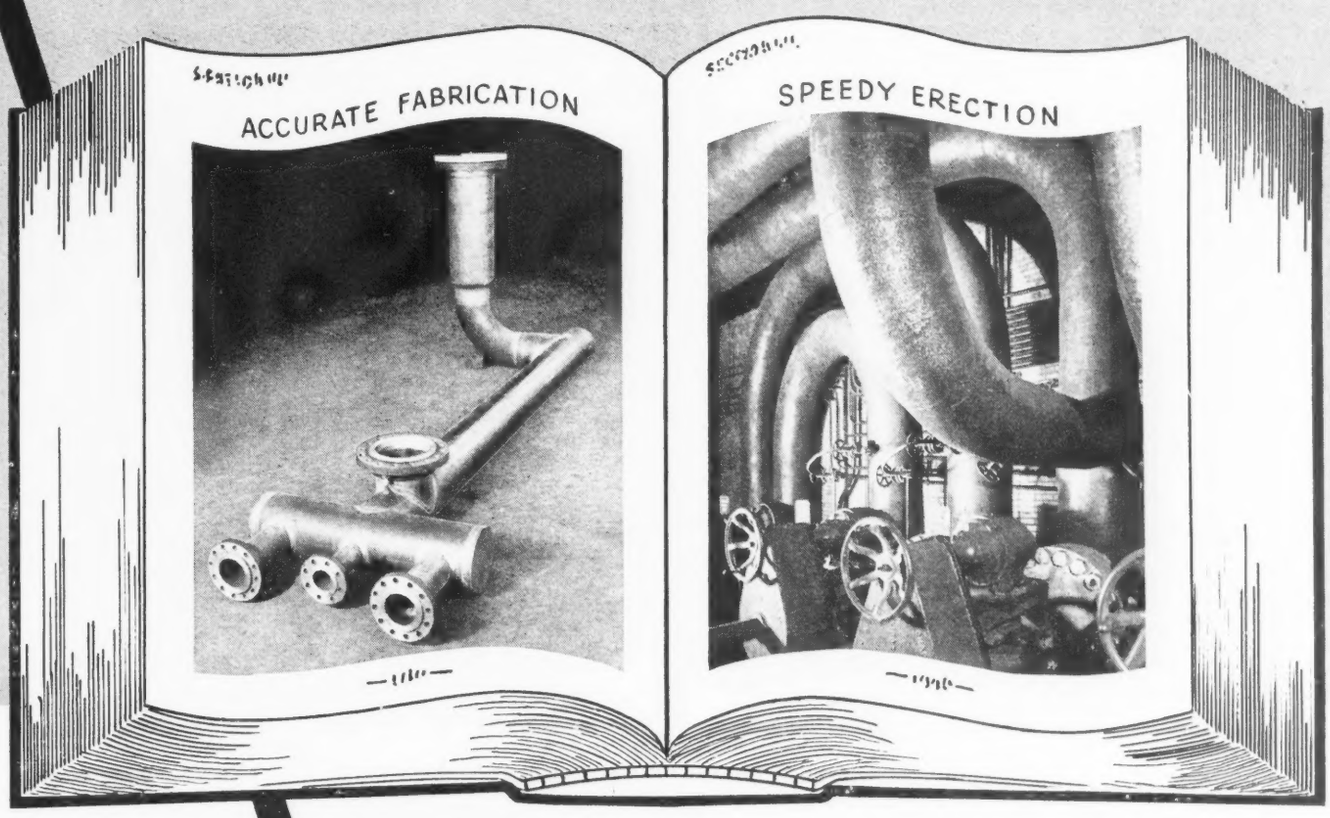
MATERIAL HANDLING MACHINERY

ROBINS

COMPLETE PIPING SERVICE



PITTSBURGH PIPING'S FABRICATING FACILITIES ARE GEARED TO THE DEMANDS OF NATIONAL DEFENSE PIPING REQUIREMENTS

FABRICATION AND ERECTION OF COMPLETE PIPING SYSTEMS

Carbon-Moly Piping	Forged Piping Materials
Carbon Steel Piping	Headers
Cast Iron Fittings	Manifolds
Cast Steel Fittings	Pipe Bends
Chrome-Moly Piping	Stainless Steel Piping
Copper Piping	Stainless Steel Tanks and Vats
Corrugated Piping	Valves
Creased Bends	Welded Stainless Steel Tubing
Expansion Bends	Welded Fittings
Flanges	Wrought Iron Piping

PITTSBURGH Piping & Equipment Company has the facilities and the experience to furnish all types of piping. A complete list would cover the entire field of piping requirements. The list at the left, while far from complete, shows many of the most often used types of piping fabricated.

In its 5 acre plant, Pittsburgh Piping has facilities for engineering and producing piping for central stations, industrial and process plants. Here is modern equipment for bending, welding, flanging, machining, heat treating, and hydraulic testing. Not only is time saved by pre-fabricating assemblies as large as shipping and erection limitations permit, but all operations can be checked and inspected for insurance before shipping.

For speedy and efficient erection, Pittsburgh Piping has specially trained field crews who maintain their schedules without interfering with other subcontractors. All assemblies are scheduled through the shop in the required sequence for erection in the field. This integration of fabrication and erection has been developed to a point where, even under present-day conditions, deliveries of completed piping can be made in a minimum of time. If you need a single pipe or a complete system, address your nearest Pittsburgh Piping office listed below.

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10 FORTY-THIRD STREET PITTSBURGH, PA.

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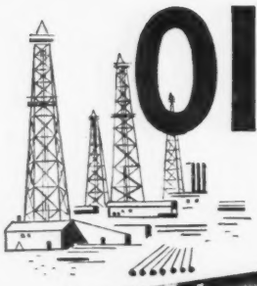
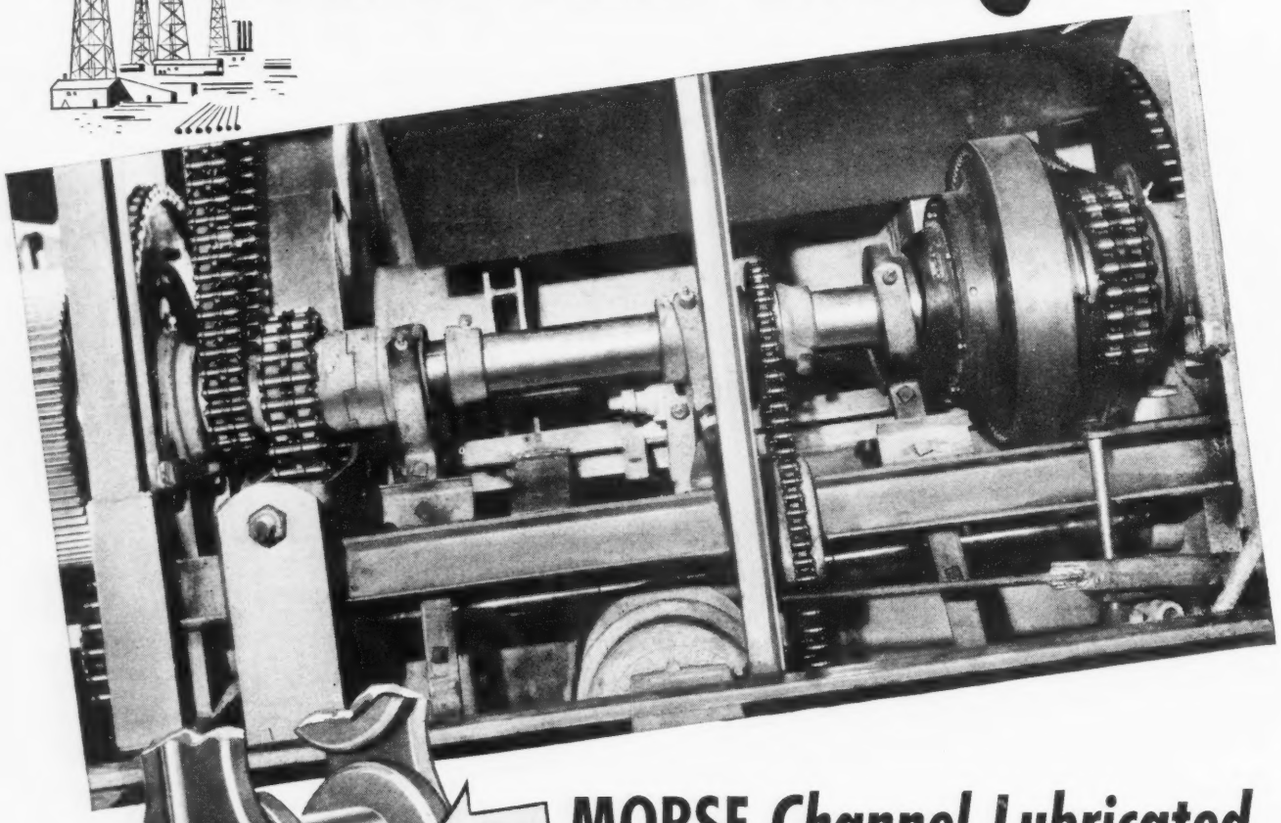
Public Sq. Bldg., Cleveland · 10 High St., Boston · Liberty Life Bldg., Charlotte · 525 Market St., San Francisco

Pittsburgh Piping

OIL is the thing....





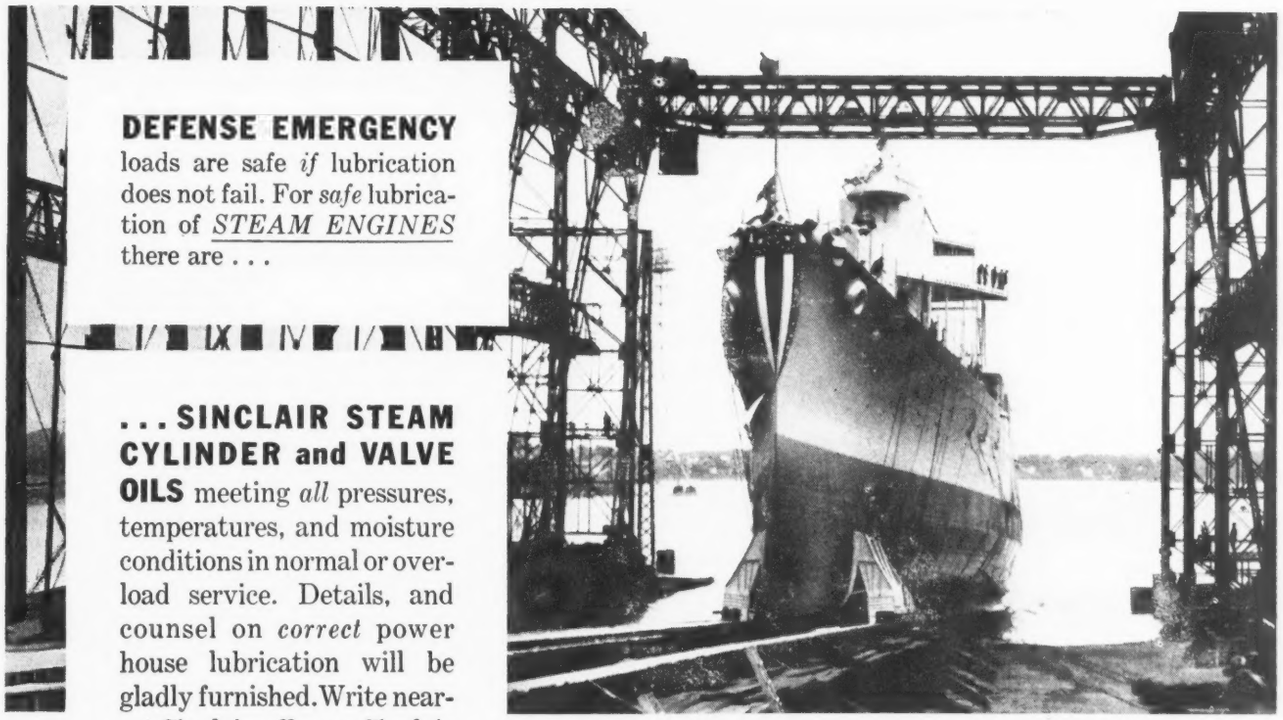
MORSE *Channel Lubricated* ROLLER CHAINS reduce wear

To assure continuous production, specify Morse, the Roller Chain with solid rollers for extra strength and a "force-feed" lubrication system in every link. Channels in the bushings lead oil through the side plates down to the pin and bushing surfaces. This exclusive design eliminates common chain failures due to insufficient lubrication. Morse Channel Lubricated Roller Chains have proven their superior performance under the most gruelling conditions on industrial drives throughout the country. Regardless of speeds, severe shocks and exposed conditions, Morse Long-Life Roller Chains will keep your machines producing longer, more efficiently, and at less cost. They are interchangeable with other roller chains, and available in all standard sizes, single and multiple widths. Investigate now!

SILENT CHAINS · ROLLER CHAINS · FLEXIBLE COUPLINGS · CLUTCHES

MORSE *positive* DRIVES

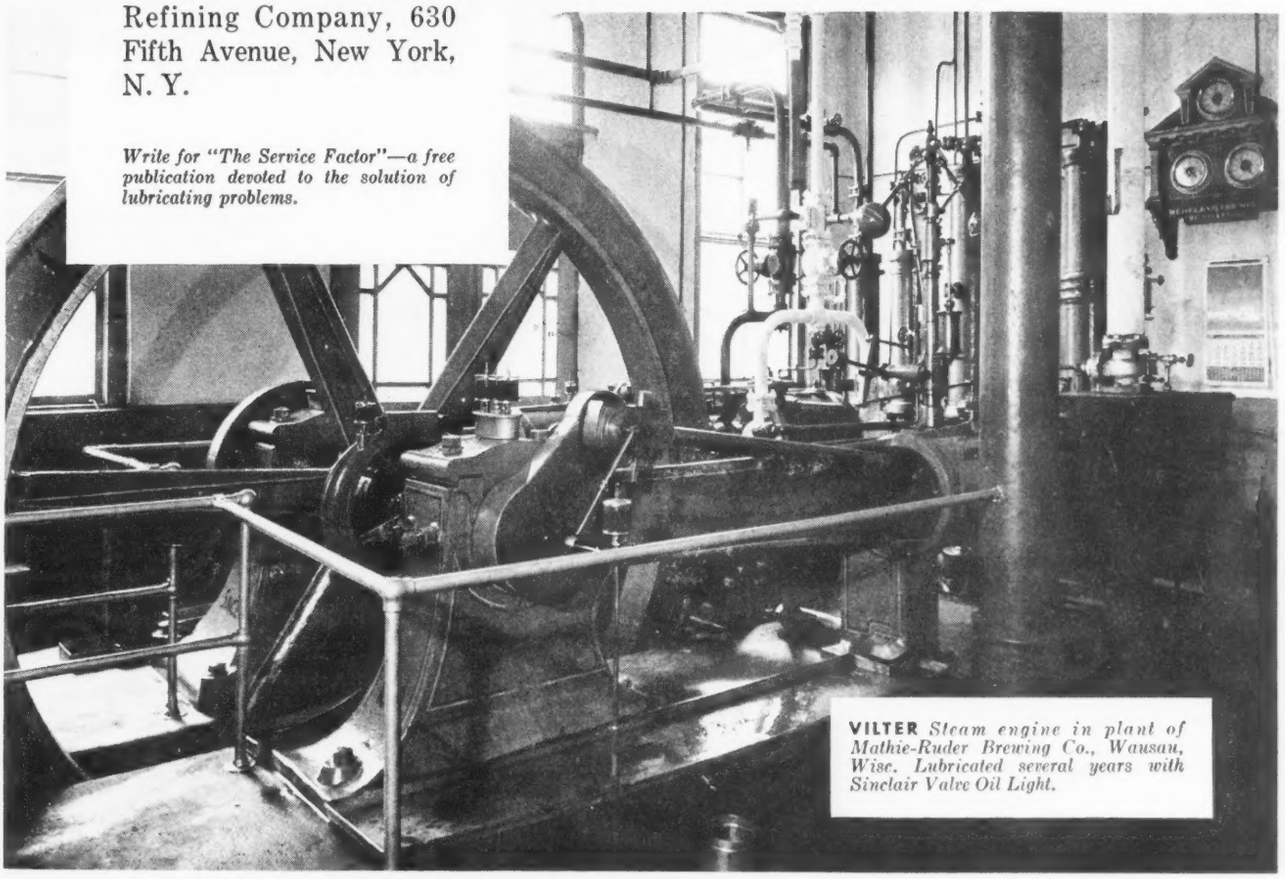
MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.



DEFENSE EMERGENCY loads are safe *if* lubrication does not fail. For *safe* lubrication of *STEAM ENGINES* there are . . .

. . . SINCLAIR STEAM CYLINDER and VALVE OILS meeting *all* pressures, temperatures, and moisture conditions in normal or overload service. Details, and counsel on *correct* power house lubrication will be gladly furnished. Write nearest Sinclair office or Sinclair Refining Company, 630 Fifth Avenue, New York, N. Y.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



VILTER *Steam engine in plant of Mathie-Ruder Brewing Co., Wausau, Wisc. Lubricated several years with Sinclair Valve Oil Light.*

SINCLAIR INDUSTRIAL OILS

SINCLAIR REFINING COMPANY (Inc.)

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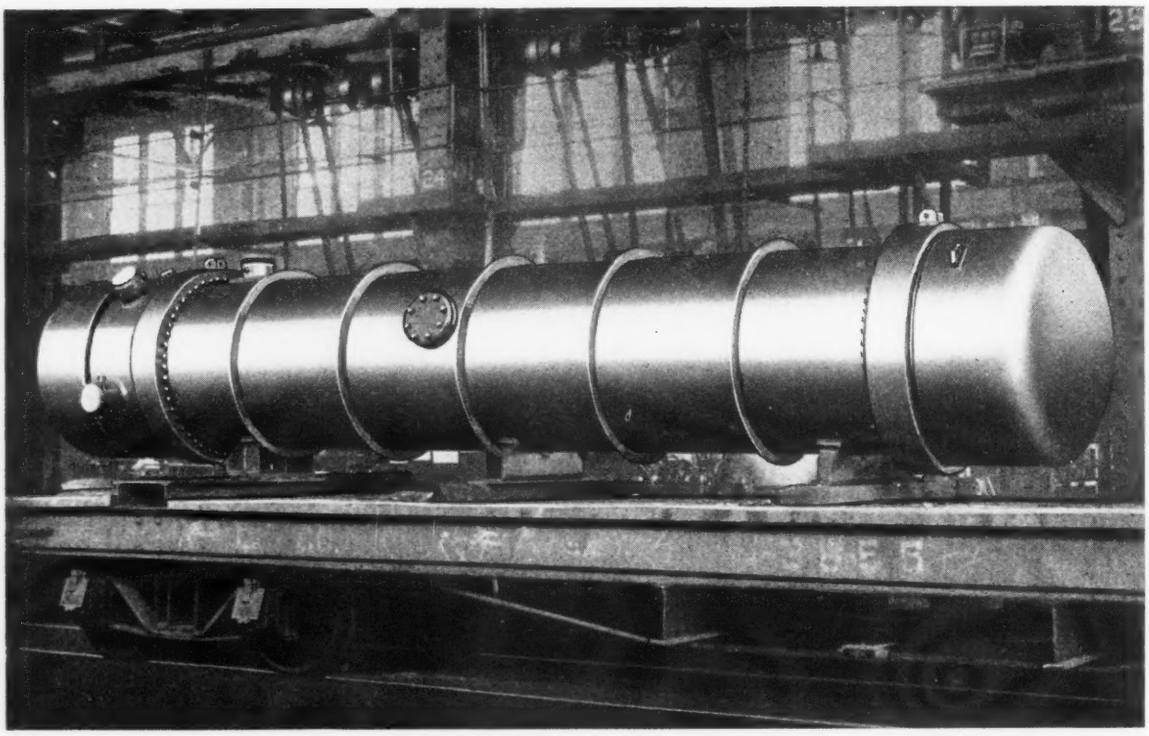
ALCO BOILER FEED WATER *Heaters*



An Alco high pressure heater prepared for shipment

• Buy Alco and be assured of a heater which will give trouble-free operation over a long period of time.

Write for Bulletins 1024 and 1030

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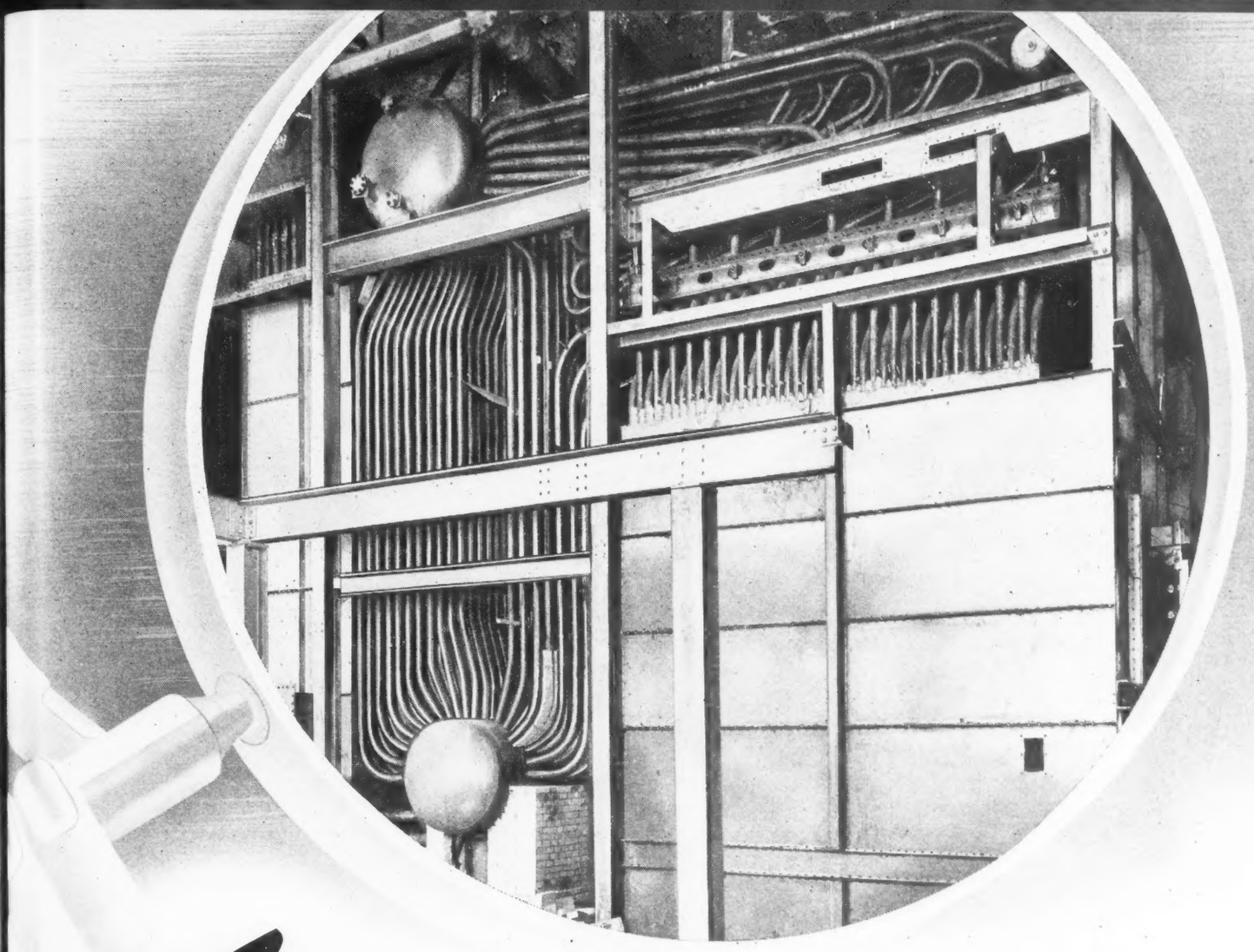
ALCO PRODUCTS DIVISION
30 CHURCH ST., NEW YORK, N. Y. **DUNKIRK, N. Y.**



4 ELECTRUNITE *features* that Speed Installation–Reduce Shut-Downs

● Today's demand for a steady flow of power -and more power—with the least possible variance of supply—greatly magnifies the value to you of the outstanding features of Republic ELECTRUNITE Boiler Tubes.

Pause a moment—and think just how important these advantages can be:

CONSISTENT UNIFORMITY—in wall thickness, diameter and concentricity—means easy, speedy installation and low-cost retubing.

HIGH DUCTILITY—that increases ease of expanding, rolling and beading—means tight, non-leaking joints in less time, with less effort and time-consuming difficulties.

COMPLETE SAFETY—proved by the testing of each tube under an internal hydrostatic pressure which is always within 20% of the minimum yield point of the steel (always far above code requirements).

SMOOTH, CLEAN SURFACE—free from corrosion-inviting scale and scale pits—free from scabs, slivers and other defects—means longer tube life and lower maintenance costs—means fewer shut-downs, less lost operating time.

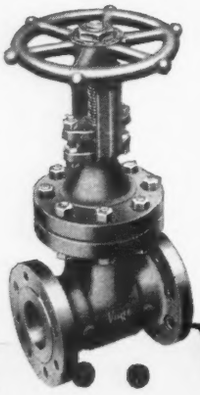
Don't underestimate the importance of the tubes in your boilers—upon their performance depends the continued operation of your plant. Play safe—and save money—use Republic ELECTRUNITE Boiler Tubes. For literature presenting the full story, write Steel and Tubes Division, Republic Steel Corporation, Cleveland, Ohio.

REPUBLIC STEEL
DEFENSE FOR AMERICA

Republic ELECTRUNITE

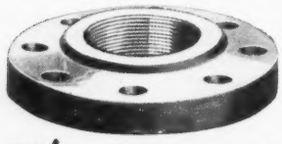
REG. U. S. PAT. OFF.

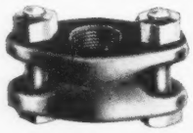
Electric Resistance Welded Boiler, Condenser and Heat Exchanger Tubes



DROP FORGED FOR SAFETY AND ECONOMY TO MEET THE MOST TRYING CONDITIONS

Valves, Fittings and Flanges by Vogt — the choice of operating men everywhere for safe and sure regulation of the high pressure and high temperature liquids and gases used in modern process work.

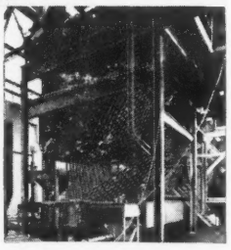




Vogt PRODUCTS are

HIGH OPERATING EFFICIENCIES AND LOW MAINTENANCE COSTS

More steam per dollar of investment—because Vogt Boilers are designed and built to fit in with specific operating conditions. Available in bent tube, sectional header, box header and return tubular types using coal, oil, gas or waste heat for fuel.



DESIGNED to RAISE

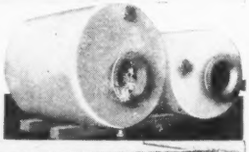
MEETING THE DEMANDS FOR OPERATING SECURITY

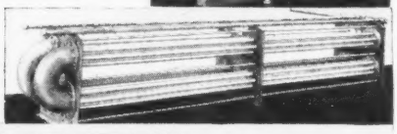
Vogt has every facility for the fabrication of stills, towers, continuous rotary filters, filter presses, oil chilling machines, heat exchangers, etc., and these products are serving the petroleum industry around the world.

OPERATING STANDARDS and

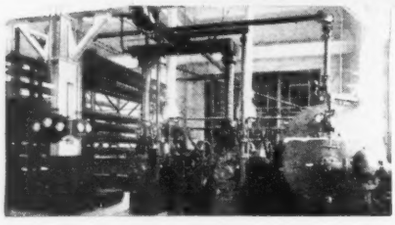
TO COMBAT CORROSION AND PREVENT PRODUCT CONTAMINATION

Process equipment made from special metals and alloys for the exacting service of the chemical plant is fabricated in our modern shops for many of the well known chemical companies.





LOWER YOUR COSTS



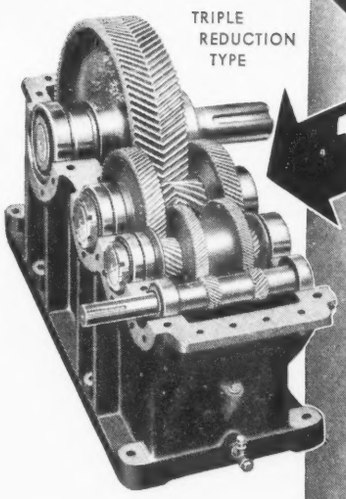
STEPS TONNAGE UP AND COSTS DOWN

Our experience of more than a half-century in building profit-making ice and refrigerating machinery is at your command. We make complete units for ice and cold storage plants, packing plants, dairies, breweries, chemical plants, oil refineries and related industries.

Vogt PRODUCTS

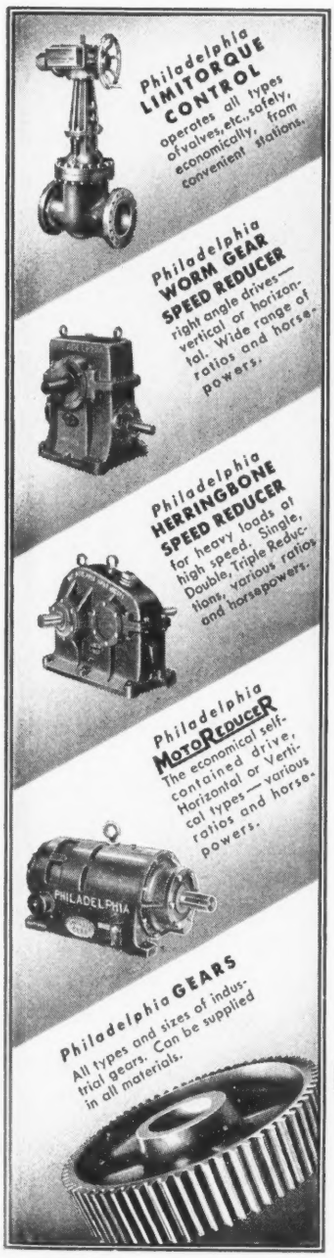
NEW YORK
PHILADELPHIA
CLEVELAND
CINCINNATI
ST. LOUIS
CHICAGO
DALLAS

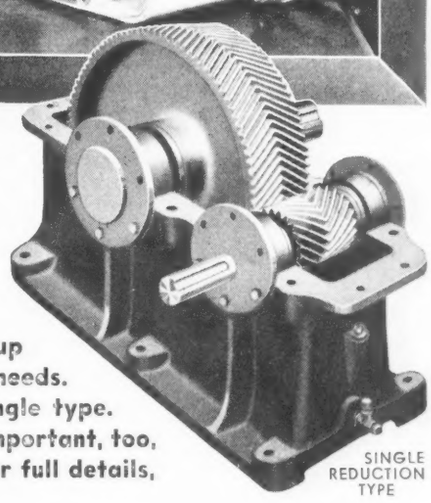
HENRY VOGT MACHINE CO., INCORPORATED LOUISVILLE, KENTUCKY



TRIPLE REDUCTION TYPE

1-2-3


Philadelphia LIMITORQUE CONTROL operates all types of valves, etc., safely, economically, from convenient stations.
Philadelphia WORM GEAR SPEED REDUCER—right angle drives—vertical or horizontal. Wide range of ratios and horsepowers.
Philadelphia HERRINGBONE SPEED REDUCER for heavy loads at high speed. Single, Double, Triple Reductions, various ratios and horsepowers.
Philadelphia MOTOREDUCER The economical self-contained drive. Horizontal or Vertical types—various ratios and horsepowers.
Philadelphia GEARS All types and sizes of industrial gears. Can be supplied in all materials.



SINGLE REDUCTION TYPE

Where you have to transmit heavy loads at high speeds or where shock is a constant factor, investigate Philadelphia Herringbone Speed Reducers before you decide on the drive. These units, made in single, double and triple reduction types can be supplied for ratios from 1.75 to 1 up to 300 to 1 and in horsepowers to fit your needs. Efficiencies are high, up to 98% on the single type. Their trouble-free performance is mighty important, too, in these days of speeded-up production. For full details, write

PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers
Erie Ave. and G St.
Philadelphia, Pa.
•
New York Pittsburgh Chicago

Partners in Defense

For many months, every Youngstown plant has been operating at capacity, with every employee giving his best to turn out the steel that the national emergency demands.

We fully appreciate your needs and are doing all we can to serve you.

Each carload of steel that leaves our plants is *your* contribution to national defense as well as ours. You and we are partners for the protection of America.

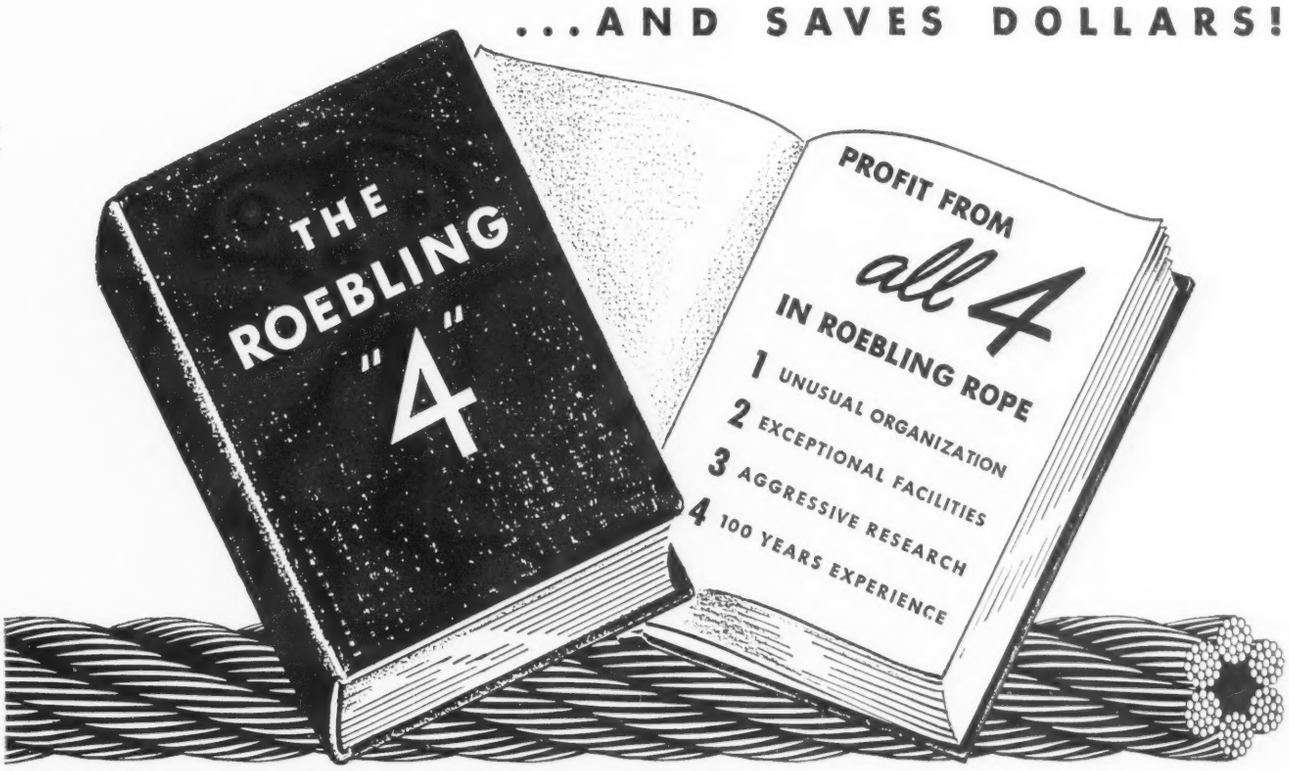
THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

25-30D

A WIRE ROPE STORY THAT MAKES SENSE

...AND SAVES DOLLARS!



ROEBLING

"Blue Center" STEEL

WIRE ROPE

PREFORMED AND NON-PREFORMED

Roebling leaves no stone unturned to give you the finest in wire rope. In Roebling "Blue Center" Steel Wire Rope you get the benefit of a combination of advantages obtainable nowhere else. It's a combination we call the "Roebling 4".

Service record after service record has proved that on the basis of *general average* rope operating cost, Roebling "Blue Center" Steel Wire Rope saves money —gives unexcelled performance!

A JOB ENTRUSTED TO ROEBLING VETERANS!

Drawing the wire for Roebling "Blue Center" Steel Wire Rope is a job that calls for great skill and painstaking care.

Most Roebling wire drawers have had from 10 to 35 years of experience!

In Roebling Wire Rope you get the benefit of the extra quality built into the rope by an organization whose skill and experience is unsurpassed

ROEBLING 1841 1941 100TH ANNIVERSARY

JOHN A. ROEBLING'S SONS COMPANY TRENTON NEW JERSEY

Branches in Principal Cities · Export Division: 19 Rector St., New York, N.Y., U.S.A. · Cable Address: "Roebling's", New York

TO MEN WITH AN EYE ON THE FUTURE

Though the immediate task is National Defense, everybody must think of more normal times ahead.

At present much of our productive capacity is pressed by the needs of Defense, which is causing some inconvenience to our regular customers.

Yet, though busy producing on order, we can *plan* for the years ahead. Even now our research laboratories are working on new materials and on the improvement of old ones. When the world has again recovered peace, we will be offering you asbestos products that will serve you better than ever before.

To accomplish this we need your help. Can you tell us of some specific problem of yours that might be solved by a new application of asbestos? Whatever your suggestion, it will be given most careful consideration in the hope it will prove practical from a manufacturing standpoint. A letter from you now may help us to serve you better in the years to come.

* * *

Nature made asbestos; Keasbey & Mattison has made it serve mankind . . . since 1873.

KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

POWER

1942

directory of manufacturers

A Buyers' Guide of over 400 power products, and who makes each

How to use this directory — Look for the noun in the product name, for example: "Strainers, oil", not "Oil strainers"; "Accumulators, steam", not "Steam accumulators". The directory is freely cross-indexed to help locate the item you are looking for

Company names are classified alphabetically under the product headings; those advertising in this issue of POWER are in bold-face type and under each of these listings appear page numbers of advertisements giving additional product information

ABSORPTION SYSTEMS, REFRIGERATION

Vogt, Henry, Machine Co, 1000 West Ormsby St, Louisville, Ky.
Adv page 174
York Ice Machy Corp, York, Pa.

ACCUMULATORS, REFRIGERATION

California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Frigidaire Commercial & Air Cond Div, General Motors Sales Corp, Dayton, Ohio
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St. Louis, Mo.
Richmond Engrg Co, 7th and Hospital Sts, Richmond, Va.
Vilter Mfg Co, 2217 S First St, Milwaukee, Wis.

AC GENERATORS

(See Generators)

AC MOTORS

(See Motors)

ACCUMULATORS, STEAM

Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Hodge Boiler Works, Boston, Mass.
Kieley & Mueller Inc, 40 W 13th St, New York, N. Y.
Koppers Co, Pittsburgh, Pa.
Adv page 143
Republic Flow Meters Co, 2222 Diversey Pkway, Chicago, Ill.
Adv pages 193, 199, 218, 254b

ADSORBERS, ODOR

Dorex Div, W B Connor Engrg Corp, 114 E 32nd St, New York, N. Y.
Pease, Anthony Equip Corp, 30 Charles River Rd, Cambridge, Mass.

AFTERCOOLERS

(See Heat Exchangers)

ASBESTOS SPECIALTIES

INSUTAPE—

The outstanding ribbon type heat insulation for spiral winding on short lengths of pipe, hard-to-get-at places, "tight spots," etc. Efficient . . . durable . . . high re-use value . . . choice of sizes.

INSUTUBE—

An ingenious, new idea in flexible heat insulation for slipping over small diameter tubes, pipes, coils, etc. Used on small, hot air heating pipes in airliners.

We are always glad to quote on asbestos specialties to meet individual requirements. Write.

UNARCO
UNION ASBESTOS & RUBBER CO.
1811 S. 54th Ave., Cicero, Illinois
CHICAGO—310 S. Michigan Ave. NEW YORK—420 Lexington Ave.
SAN FRANCISCO—116 New Montgomery St.
Contractor-Distributors Located in Principal Industrial Centers

AIR COMPRESSORS

(See Compressors)

AIR CONDITIONERS, CENTRAL STATION

Air & Refrigeration Corp, New York, N. Y.
Airtemp Div, Chrysler Corp, Dayton, Ohio
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Bahnson Co, Winston-Salem, N. C.
Bryant Heater Co, 17825 St Clair Ave, Cleveland, Ohio
Carrier Corp, Syracuse, N. Y.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Frigidaire Commercial & Air Cond Div, General Motors Sales Corp, Dayton, Ohio
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Refrigeration Div, Yates-American Machine Co., Beloit, Wis.
Hastings Air Conditioning Co, Hastings, Neb.
Kennard, Sam, Inc, 3333 Market St, St Louis, Mo.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St Louis, Mo.
Micheli Air Conditioning Co, Schenectady, N. Y.
Modine Mfg Co, Racine, Wis.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Palmers Mfg Corp, Phoenix, Ariz.
Parks-Cramer Co, Fitchburg, Mass.
Refrigeration Economics Co, Canton, Ohio
Richmond Engrg Co, 7th and Hospital Sts, Richmond, Va.
Ross, J O, Engrg Corp, New York, N. Y.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Typhoon Air Conditioning Co, 252 W 26th, New York, N. Y.
Vilter Mfg Co, 2217 S First St, Milwaukee, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Machy Corp, York, Pa.

AIR CONDITIONERS, UNIT, INTEGRAL COMPRESSOR

Airtemp Div, Chrysler Corp, Dayton, Ohio
Carrier Corp, Syracuse, N. Y.
Curtis Refrigerating Machine Co, St Louis, Mo.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Frigidaire Commercial & Air Cond Div, General Motors Sales Corp, Dayton, Ohio
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Ice Cooling Appliance Corp, Morrison, Ill. *(Ice-cooled units)*
Philco Corp, Philadelphia, Pa.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Typhoon Air Conditioning Co, 252 W 26th St, New York, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Machy Corp, York, Pa.

AIR CONDITIONERS, UNIT, REMOTE COMPRESSOR

Air & Refrigeration Corp, New York, N. Y.
Carrier Corp, Syracuse, N. Y.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Curtis Refrigerating Machine Co, St Louis, Mo.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Frigidaire Commercial & Air Cond Div, General Motors Sales Corp, Dayton, Ohio
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Kennard, Sam, Inc, 3333 Market St, St Louis, Mo.
McQuay, Inc, Minneapolis, Minn.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Refrigeration Economics Co, Canton, Ohio
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Typhoon Air Conditioning Co, 252 W 26th St, New York, N. Y.
Vilter Mfg Co, 2217 S First St, Milwaukee, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Machinery Corp, York, Pa.

AIR HEATERS

(See Preheaters, Air)

ALARM SYSTEMS, FIRE

(See Sprinkler Systems, Fire)

ALARM SYSTEMS, FLAME FAILURE

Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Ess Instrument Co, 30 Irving Place, New York, N. Y.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.
Stock Engrg Co, 9805 Theodore Ave, Cleveland, Ohio
Wheelco Instruments Co, 1929 S Halstead Ave, Chicago, Ill.
Adv page 243

ALARMS, LOW-WATER

(See Water Columns)

HEAT INSULATION PRODUCTS

B-H

Developed by Insulation Engineers, BALDWIN-HILL products have proved highly effective for providing high operating efficiencies by eliminating preventable waste of heat and power. There's a type to meet every condition of service.

B-H ROCKWOOL BLANKET
Made from high temperature and moisture resisting Black Rockwool, felted between various types of metal fabrics. Effective up to 1200° F.

B-H No. 1 Insulating CEMENT
For odd shapes as well as flat surfaces. Easy to mix and apply. Effective up to 1800° F. Reclaimable up to 1200° F. High coverage, low volume shrinkage. Rust inhibitor prevents corrosion.

B-H MONO-BLOCK
Preformed block felted of B-H Black Rockwool and bonded together to form lightweight, heat and moisture resistant insulation. Effective up to 1600° F.

B-H WEATHERSEAL
A durable weatherproof coating to protect insulated surfaces against disintegration and loss of efficiency through infiltration of air, moisture.

Send for CATALOG
showing complete line including Pipe Covering, Low Temperature Insulating Board, Insulating Wool, Duct Lining, Diatomaceous Earth and Asbestos Products.

BALDWIN-HILL CO.
575 KLAGG AVE.
TRENTON, N. J.
Branch Offices: NEW YORK CHICAGO KALAMAZOO, MICH.

ALLOYS, METALS FOR SPECIAL SERVICE

Allegheny Ludlum Steel Corp, Pittsburgh, Pa.
American Brass Co, Waterbury, Conn.
American Manganese Steel Div, American Brake Shoe & Foundry Co, 397 E 14th St, Chicago, Ill.
Duriron Co, Inc, Dayton, Ohio
Electro Refractories & Alloys Corp, Andrews Bldg, Buffalo, N. Y.
Harris, Arthur, & Co, 212 N Aberdeen St, Chicago, Ill.
Haynes Stellite Co, Kokomo, Ind.
Hills-McCanna Co, 3025 N Western Ave, Chicago, Ill.
International Nickel Co, 67 Wall St, New York, N. Y.
Adv pages 18, 151
Lukens Steel Co, Coatesville, Pa.
Meehanite Metal Corp, Dept A, 311 Ross St, Pittsburgh, Pa.
Mueller Brass Co, 1925A Lapeer Ave, Port Huron, Mich.
National Lead Co, 111 Broadway, New York, N. Y.
Phelps Dodge Copper Products Corp, 40 Wall St, New York, N. Y.
Plouff Co, 1151 Columbus Ave, Boston, Mass.
Revere Copper & Brass, Inc, 230 Park Ave, New York, N. Y.
Adv pages 156, 157
Ryerson, Jos T & Son, Inc, 16th & Rockwell Sts, Chicago, Ill.
Scovill Mfg Co, 99 Mill St, Waterbury, Conn.
Adv page 105
Timken Roller Bearing Co, Canton, Ohio
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

ALUMINUM PAINT

(See Paint, Aluminum)

AMMETERS

Bristol Co, Waterbury, Conn.
Columbia Electric Mfg Co, 4519 Hamilton Ave, Cleveland, Ohio
Esterline-Angus Co, Box 596, Indianapolis, Ind.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
Adv page 242
Stewart-Warner Corp, 1826 W Diversey Pkwy, Chicago, Ill.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

AMMONIA VALVES

(See Valves, Refrigeration)

ANALYZERS, CO$_2$, PORTABLE

Bacharach Industrial Inst Co, 7000 Bennett St, Pittsburgh, Pa.
Defender Automatic Regulator Co, St Louis, Mo.
Dwyer, F W, Mfg Co, 561 Washington St, Chicago, Ill.
Eimer & Amend, 635 Greenwich St, New York, N. Y.
Engelhard, Charles, Inc, 234 N J R R Ave, Newark, N. J.
Friez, Julien P, Div, 4 N Central Ave, Baltimore, Md.
Hays Corp, 905 8th St, Michigan City, Ind.
Adv page 195
Hotstream Heater Co, Cleveland, Ohio
Permutit Co, Dept A, 330 West 42nd St, New York, N. Y.
Adv page 125
Preferred Utilities Mfg Corp, New York, N. Y.

ANALYZERS, VIBRATION

Electrocon Co, 7 Varick St, New York, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

ANEMOMETERS

Friez, Julien P, & Sons, 4 N Central Ave, Baltimore, Md.
Taylor Instrument Cos, Rochester, N. Y.

ARC-WELDING EQUIPMENT

(See Welding Equipment)

ARCHES, BOILER

Acme Brick Co, Fort Worth, Tex.
American Arch Co, 68 E 42nd St, New York, N. Y.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bernitz Furnace Appliance Co, 89 Broad St, Boston, Mass.
Bigelow Co, 200–220 River St, New Haven, Conn.
Bigelow-Liptak Corp, 2840 W Grand Blvd, Detroit, Mich.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Carborundum Co, Dept P, Perth Amboy, N. J.
Chicago Fire Brick Co, 1463 Elston Ave, Chicago, Ill.
Detrick, M H, Co, 140 S Dearborn St, Chicago, Ill.
DeWolf Furnace Corp, 77 South Ave, Rochester, N. Y.
Adv page 254-c
Furnace Economy Co, 210 N Wells St, Chicago, Ill.
Green, A P, Firebrick Co, 1020 Breckenridge, Mexico, Mo.
Harbison-Walker Refractories Co, 1800 Farmers Bank Bldg, Pittsburgh, Pa.
International Engrg Wks Inc, Framingham, Mass.
Laclede-Christy Clay Products Co, 411 N 7th St, St Louis, Mo.
McLeod & Henry Co, Inc, 31 Monroe St, Troy, N. Y.
Mexico Refractories Co, Mexico, Mo.
Plibrico Jointless Firebrick Co, 1818 Kingsbury, Chicago, Ill.
Adv pages 181, 232, 254c
Ramtite Co, 2563 W 18th St, Chicago, Ill.
Reintjes, Geo P, Co, 2517 Jefferson, Kansas City, Mo.
Ryerson, Jos T, & Sons Inc, 16th & Rockwell Sts, Chicago, Ill.
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

ASBESTOS PRODUCTS

(See Also Boards, Insulation, Pipe and Packing)
Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.
Adv pages 180, 186, 217
Carey, Philip, Mfg Co, Lockland, Ohio
Adv page back cover
Ehret Magnesia Mfg Co, Inc, Valley Forge, Pa.
Adv pages 50, 51
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Keasbey & Mattison Co, Butler Pike, Ambler, Pa.
Adv page 178
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Porter, H W, & Co, 825 Frelinghuysen Ave, Newark, N. J.
Adv page 192
Standard Asbestos Mfg Co, 820 West Lake St, Chicago, Ill.
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Union Asbestos & Rubber Co, 1821 S 54th Ave, Cicero, Ill.
Adv pages 180, 216, 217, 248

ASH-HANDLING EQUIPMENT

(See Conveyors, Sluices, Storage)

BAFFLES, BOILER

Acme Brick Co, Ft Worth, Tex.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Chicago Fire Brick Co, 1463 Elston Ave, Chicago, Ill.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Harbison-Walker Refractories Co, 1800 Farmers Bank Bldg, Pittsburgh, Pa.
Laclede-Christy Clay Products Co, 411 N 7th St, St. Louis, Mo.
Mexico Refractories Co, Mexico, Mo.
Plibrico Jointless Firebrick Co, 1818 Kingsbury, Chicago, Ill.
Adv pages 181, 232, 254c
Power Plant Efficiency Co, 155 E Market St, Indianapolis, Ind.
Quigley Co, 56 W 45th St, New York, N. Y.
Ramtite Co, 2563 W 18th St, Chicago, Ill.
Reintjes, Geo P, Co, 2517 Jefferson, Kansas City, Mo.
Seabord Refractories Co, Box 151, Perth Amboy, N. J.
Smith, Sanford C, Refractories Inc, 1715 Niagara St, Buffalo, N. Y.
Adv page 232

BALANCED VALVES

(See Valves, Balanced)

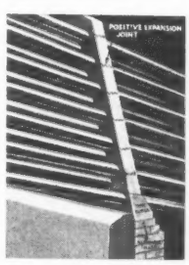
BAROMETERS

Bristol Co, Waterbury, Conn.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, 4 N Central Ave, Baltimore, Md.
Tagliabue, C J Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Uehling Instrument Co, 470 Getty Ave, Paterson, N. J.

BASES, MOTOR

Alexander Bros, 410 N 3rd St, Philadelphia, Pa.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Pulley Co, 4200 Wissahickon Ave, Philadelphia, Pa.
Chicago Belting Co, Chicago, Ill.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Grand Rapids Blow Pipe & Dust Arrester Co, Grand Rapids, Mich.
Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.
Korfund Co, 48-23 32nd Place, Long Island City, N. Y.

BECO-TURNER BAFFLES



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Adv page 185
Rockwood Mfg Co, 1801 English Ave, Indianapolis, Ind.

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Edison, Thomas A, Inc, West Orange, N. J.
Electric Storage Battery Co, Allegheny Ave & 19th St, Philadelphia, Pa.
Adv page 127
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Philadelphia Storage Battery Co, Ontario & C Sts, Phila, Pa.
Philco Corp, Storage Battery Div, Trenton, N. J.
Willard Storage Battery Co, 246 E 131 St, Cleveland, Ohio

BEARINGS, ANTI-FRICTION

Ahlberg Bearing Co, 4732 Whipple St, Chicago, Ill.
Atlantic Gear Works, 126 Lafayette St, New York, N. Y.
Bantam Bearings Corp, South Bend, Ind.
Chicago Pulley & Shafting Co, Chicago, Ill.
Dodge Mfg Co, Mishawaka, Ind.
Fafnir Bearing Co, 77 Booth St, New Britain, Conn.
Gwilliam Co, 370 Furman St, Brooklyn, N. Y.
H & O Machinery & Engrg Co, 281 Passaic St, Newark, N. J.
Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio
Hyatt Bearings Div, General Motors Corp, Anderson, Ind.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Link-Belt Co, 519 N Holmes Ave, Indianapolis, Ind.
Adv page 3
McGill Mfg Co, 270 Indiana Ave, Valparaiso, Ind.
Medart Co, 3548 De Kalb St, St. Louis, Mo.
New Departure Div, General Motors Corp, Bristol, Conn.
Nice Ball Bearing Co, 30th & Nicetown Lane, Phila, Pa.
Norma-Hoffman Bearings Corp, Stamford, Conn.
Royersford Foundry & Machine Co, 75 Main, Royersford, Pa.
Shafer Bearing Corp, 35 E Wacker Drive, Chicago, Ill.
SKF Industries, Inc, Front St & Erie Ave, Philadelphia, Pa.
Adv page 260
Standard Pressed Steel Co, Jenkintown, Pa.
Adv pages 197, 212
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Timken Roller Bearing Co, Canton, Ohio
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

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American Crucible Products Co, Lorain, Ohio
Barry Co, Muscatine, Iowa
Bearium Metals Corp, 258 State St, Rochester, N. Y.
Bunting Brass & Bronze Co, Toledo, Ohio
Chicago Pulley & Shafting Co, Chicago, Ill.
Continental Diamond Fibre Co, Dept 18, Newark, Del.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Johnson Bronze Co, New Castle, Pa.
Lignum-Vitae Products Corp, Jersey City, N. J.
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Neveroil Bearing Co, Wakefield, Mass.
Nolu Oilless Bearing Co, 16 E Johnson, Philadelphia, Pa.
Rhoades, R W, Metaline Co, 50-19 5th St, Long Id City, N. Y.

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Bunting Brass & Bronze Co, Toledo, Ohio
Chicago Pulley & Shafting Co, Chicago, Ill.
Chrysler Corp, Amplex Div, P O Box 2718, Detroit, Mich.
Green Fuel Economizer Co, 627 Main St, Beacon, N. Y.
Adv pages 24, 25
Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio
Johnson Bronze Co, New Castle, Pa.
Kingsbury Machine Works, Inc, 4324 Tackawanna St, Phila, Pa.
Link-Belt Co, 2410 W 18th St, Chicago, Ill.
Adv page 3
Magnolia Metal Co, 120 Bay Way, Elizabeth, N. J.
Neveroil Bearing Co, Wakefield, Mass.
Saginaw Bearing Co, 825 S Water St, Saginaw, Mich.
Standard Pressed Steel Co, Jenkintown, Pa.
Adv pages 197, 212
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

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Bantam Bearings Corp, South Bend, Ind.
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Link-Belt Co, 519 N Holmes Ave, Indianapolis, Ind.
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Nice Ball Bearing Co, 30th & Nicetown Lane, Phila, Pa.
Norma-Hoffman Bearings Corp, Stamford, Conn.
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SKF Industries, Inc, Front St & Erie Ave, Philadelphia, Pa.
Adv page 260
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BELT CONVEYORS

(See Conveyors)

BELT DRESSING

(See Dressing, Belt)

BELT LACING

(See Lacing, Belt)

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Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Cincinnati Rubber Mfg Co, 4901 Franklin Ave, Cincinnati, O.
Dick, R & J, Co, Colfax Ave, Passaic, N. J.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, O.
Adv page 20
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Manheim Mfg & Belting Co, 375 Steigel St, Manheim, Pa.
New York Belting & Packing Co, Passaic, N. J.
Quaker Rubber Corp, Comly & Milnor Sts, Philadelphia, Pa.
Raniville, F, Co, Grand Rapids, Mich.
Republic Rubber Div, Lee Tire & Rubber Corp, Youngstown, Ohio
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Scandinavia Belting Co, 250 Central Ave, Newark, N. J.
Stanley Belting Corp, 15 N Jefferson St, Chicago, Ill.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Thermoid Rubber Div, Trenton, N. J.
U. S. Rubber Co, 1230 6th Ave, New York, N. Y.
Wickwire Spencer Steel Co, 500 Fifth Ave, New York, N. Y.

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Chicago Rawhide Mfg Co, Chicago, Ill.
Fisher Leather Belting Co, Philadelphia, Pa.
Graton & Knight Co, Worcester, Mass.
Houghton, E F, & Co, 244-50 W Somerset, Philadelphia, Pa.
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Page Belting Co, Concord, N. H.
Pennwell Oil & Belting Co, Inc, 5 White St, New York, N. Y.
Philadelphia Belting Co, 6th & Spring Garden Sts, Philadelphia, Pa.
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Rhoads, J E, & Sons, 35 N 6th St, Philadelphia, Pa.
Schieren, Chas A, Co, 30-39 Ferry St, New York, N. Y.
Schwartz Belting Co, 74 Murray St, New York, N. Y.
Slip-Not Belting Corp, Kingsport, Tenn.
Williams, I B, & Sons, 73 Murray St, New York, N. Y.

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Boston Woven Hose & Rubber Co, Cambridge, Mass.
Cincinnati Rubber Mfg Co, 4901 Franklin Ave, Cincinnati, O.
Garlock Packing Co, 400 Main St, Palmyra, N. Y.
Adv page 135
Gates Rubber Co, Denver, Colo.
Gilmer, L H, Co, 7360 Keystone St, Tacony, Phila, Pa.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, O.
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Hewitt Rubber Co, Buffalo, N. Y.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
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Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
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U. S. Rubber Co, 1230 6th Ave, New York, N. Y.

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Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
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Baldwin Belting & Leather Co, 85 Chambers St, New York, N. Y.
Chicago Belting Co, Chicago, Ill.
Continental Rubber Wks, Erie, Pa.
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Gates Rubber Co, Denver, Colo.
Gilmer, L H, Co, 7360 Keystone St, Tacony, Philadelphia, Pa.
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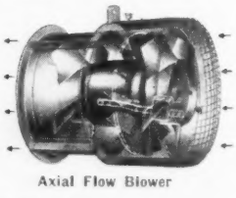
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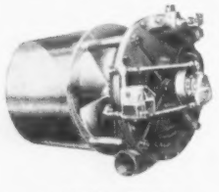
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Page Belting Co, Concord, N. H.
Raniville, F, Co, Grand Rapids, Mich.
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Rockwood Mfg Co, 1801 English Ave, Indianapolis, Ind.
Schieren, Chas A, Co, 30-39 Ferry St, New York, N. Y.
Thermoid Rubber Div, Trenton, N. J.
U. S. Rubber Co, 1230 6th Ave, New York, N. Y.
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

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Fuller Co, 111 Bridge St, Catasaqua, Pa.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Grand Rapids Blow Pipe & Dust Arrester Co, Grand Rapids, Mich.
Link-Belt Co, 300 W Pershing Road, Chicago, Ill.
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Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Stock Engrg Co, 9805 Theodore Ave, Cleveland, Ohio

BLOWDOWN SYSTEMS, BOILER, CONTINUOUS

Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Dearborn Chemical Co, 310 S Michigan Ave, Chicago, Ill.
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
Adv page 238
Henszey Co, Dept D14, Watertown, Wis.
Adv pages 183, 213, 220, 232
Madden, P E, Co, 352 W Walton St, Chicago, Ill.
Permutit Co, Dept A, 330 W 42 St, New York, N. Y.
Adv page 125
Rice, Cyrus Wm, & Co, 15 Noble Ave, Pittsburgh, Pa.
Scaife, Wm B, & Sons Co, River & Ann St, Oakmont, Pa.
Steam & Combustion Co, Racine, Wis.
Strong, Carlisle & Hammond Co, 1392 W 3rd, Cleveland, O.

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(See Also Fans, Turbo-Blowers)
Advance Aluminum Castings Corp, 2742 W 36th Pl, Chicago, Ill.
Allen Billmyre Corp, Daily News Bldg, New York, N. Y.
Allen, E H, & Co, Dept P, 22 Dorrance St, Boston, Mass.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Coal Burner Co, E Superior St, Chicago, Ill.
Bayley Blower Co, 1817 S 66th St, Milwaukee, Wis.
Beach-Russ Co, 50 Church St, New York, N. Y.
Breuer Electric Mfg Co, 5100 N Ravenswood Ave, Chicago, Ill.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Campbell Heating Co, Des Moines, Iowa
Carling Turbine Blower Co, 25 St John's Rd, Worcester, Mass.
Champion Blower & Forge Co, Lancaster, Pa.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Coppus Engrg Corp, 350 Park Ave, Worcester, Mass.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Diamond Iron Works, Inc, Minneapolis, Minn.
Eclipse Fuel Engineering Co, 707 S Main St, Rockford, Ill.
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Erie Electric Co, 124 Church St, Buffalo, N. Y.
Adv page 244
Garden City Fan Co, 332 S Michigan Ave, Chicago, Ill.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Grand Rapids Blow Pipe & Dust Arrester Co, Grand Rapids, Mich.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Green Fuel Economizer Co, Inc, 627 Main St, Beacon, N. Y.
Adv pages 24, 25
Hastings Air Conditioning Co, Hastings, Neb.
Ilg Electric Ventilating Co, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
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Kirk & Blum Mfg Co, 2831 Spring Grove Ave, Cincinnati, O.
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Niagara Blower Co, 6 E 45th St, New York, N. Y.
Palmers Mfg Co, Phoenix, Ariz.
Power Turbo-Blower Co, 30 Vesey St, New York, N. Y.
Roots-Connersville Blower Corp, Connersville, Ind.
Skinner Heating & Ventilating Co, 1990 N 9th, St Louis, Mo.
Spencer Turbine Co, 488 New Park Ave, Hartford, Conn.
Standard Electrical Tool Co, 1918 W 8th St, Cincinnati, Ohio
Sterling Blower Co, 791 Windsor St, Hartford, Conn.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Surface Combustion Corp, Toledo, Ohio
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
U S Hoffman Mach Corp, 105 4th Ave, New York, N. Y.
Wing, L J Mfg Co, W 14th St & 7th Ave, New York, N. Y.
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BLOWERS, SCAVENGING & SUPERCHARGING

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Roots-Connersville Blower Corp, Connersville, Ind.
U S Hoffman Mach Corp, 105 4th Ave, New York, N. Y.

BLOWERS, SOOT

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Bayer Co, 4026 Chouteau Ave, St Louis Mo.
Diamond Power Specialty Corp, Box 288, Detroit, Mich.
Adv pages 12-13
General Specialty Co, Inc, 67 Carroll St, Buffalo, N. Y.
Hahn Engineering Div, 233 Broadway, New York, N. Y.
Adv page 194
Marion Machine Foundry & Supply Co, Marion, Ind.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Vulcan Soot Blower Co, Du Bois, Pa.

BLUEPRINT MACHINES

(See Printing Machines)

BOARDS, ASBESTOS

Carey, Philip, Mfg Co, Lockland, Ohio
Adv page back cover
Ehret Magnesia Mfg Co, Inc, Valley Forge, Pa.
Adv pages 50, 51
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Keasbey & Mattison Co, Butler Pike, Ambler, Pa.
Adv page 178
Standard Asbestos Mfg Co, 820 W Lake St, Chicago, Ill.

BOARDS, GAGE

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Adv pages 26, 27
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Lonergan, J E, Co, 211 Race St, Phila, Pa.
Adv pages 209, 254b
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Taylor Instrument Cos, Rochester, N. Y.

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(See Water Treatment, Softeners)

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(See Cleaners, Boiler-Tube)

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(See Tubes, Boiler)

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Adv pages 14, 15, 44, 45, 145
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Adv pages 54, 55

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Adv page 172
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Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
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Murray Iron Works Co, Burlington, Iowa
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Birmingham Boiler & Engrg Co, Birmingham, Ala.
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Brownell Co, 301 N Findlay St, Dayton, Ohio
Burnham Boiler Corp, Irvington, N. Y.
California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
Cleaver-Brooks Co, 5100 N 33rd St, Milwaukee, Wis.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Eclipse Fuel Engrg Co, 707 S Main St, Rockford, Ill.
Erie City Iron Works, 1422 East Ave, Erie, Pa.
Farrar & Trefts, Inc, Buffalo, N. Y.
Fitzgibbons Boiler Co, Inc, 101 Park Ave, New York, N. Y.
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Hodge Boiler Works, East Boston, Mass.
International Engrg Wks, Inc, Framingham, Mass.
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Kewanee Boiler Corp, Kewanee, Ill.
Kroeschell Boiler Co, Racine, Wis.
Lookout Boiler & Mfg Co, Chattanooga, Tenn.
Mears-Kane-Ofeldt, Inc, 1903 E Hagert St, Philadelphia, Pa.
Milwaukee Reliance Boiler Works, Milwaukee, Wis.
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Pierce Butler Radiator Co, 701 Nichols Ave, Syracuse, N. Y.
Titusville Iron Works Co, Titusville, Pa.
Union Iron Works, Erie, Pa.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Webster, Howard J, Greene & Hortter Sts, Philadelphia, Pa.
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.
Willamette Iron & Steel Corp, Portland, Ore.

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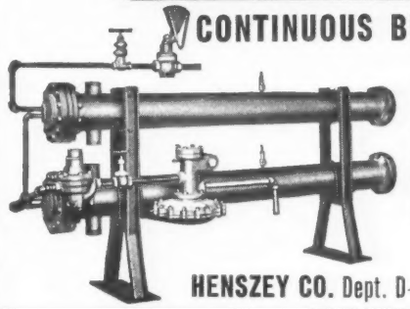
Adv pages 4, 5, 6, 7, 34
Bass Foundry & Machine Co, Fort Wayne, Ind.
Bigelow Co, 200-220 River St, New Haven, Conn.

HENSZEY

CONTINUOUS BLOWDOWN



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Adv pages 38, 39
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Adv page 263
Erie City Iron Works, 1422 East Ave, Erie, Pa.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
International Boiler Works Co, E Stroudsburg, Pa.
International Engrg Wks Inc, Framingham, Mass.
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Keeler, Godfrey, Co, Inc, 77 Warren St, New York, N. Y.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Kroeschell Boiler Co, Racine, Wis.
Leffel, James & Co, Springfield, O.
Mears-Kane-Ofeldt Inc, 1903 E Hagert St, Philadelphia, Pa.
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Page Boiler Co, 815 W Webster Ave, Chicago, Ill.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Springfield Boiler Co, 1903 E Capitol Ave, Springfield, Ill.
Titusville Iron Works Co, Titusville, Pa.
Union Boiler & Mfg Co, Lebanon, Pa.
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Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

BOILERS, WASTE-HEAT

American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bigelow Co, 200-220 River St, New Haven, Conn.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Edge Moor Iron Works, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Hodge Boiler Works, East Boston, Mass.
International Engrg Wks Inc, Framingham, Mass.
Maxim Silencer Co, 86 Homestead Ave, Hartford, Conn.
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Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Springfield Boiler Co, 1903 E Capitol Ave, Springfield, Ill.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174

BOXES, TOOL

Littleford Bros, 438 E Pearl St, Cincinnati, Ohio
Adv page 185
Snap-on Tools Corp, Kenosha, Wis.

BREAKERS, CIRCUIT, AIR

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Cutler-Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
I-T-E Circuit Breaker Co, 19th & Hamilton St, Phila, Pa.
Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
Adv page 242
Square D Co, Rivard & Piquette Sts, Detroit, Mich.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

BREAKERS, CIRCUIT, OIL

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Delta-Star Electric Co, Fulton St, Chicago, Ill.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Pacific Electric Mfg Corp, 5815 3rd St, San Francisco, Calif.
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Adv page 242
Southern States Equipment Corp, Birmingham, Ala.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

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Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Brownell Co, 301 N Findlay St, Dayton, Ohio
Caldwell, W E, Co, Inc, 280 Brandeis St, Louisville, Ky.
California Steel Products Co, Barrett & A Sts, Richmond, Cal.
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Chicago Bridge & Iron Co, 2454 McCormick Bldg, Chicago, Ill.
Colonial Iron Works Co, 17643 St Clair Ave, Cleveland, Ohio
Connery Construction Co, 2nd & Luzerne Sts, Phila, Pa.
Adv page 184
Dover Boiler Works, 90 E Dickerson St, Dover, N. J.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Graver Tank & Mfg Co, Inc, East Chicago, Ind.
Green Fuel Economizer Co, Inc, 627 Main St, Beacon, N. Y.
Adv pages 24-25
Hodge Boiler Works, East Boston, Mass.
International Engrg Works, Inc, Framingham, Mass.
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Kirk & Blum Mfg Co, 2831 Spring Grove Ave, Cincinnati, Ohio
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Michelman Steel Constr Co, Quincy, Ill.
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Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
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Titusville Iron Works Co, Titusville, Pa.
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Union Iron Works, Erie, Pa.
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.
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BRICK, FIRE

Acme Boiler Co, Fort Worth, Tex.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bernitz Furnace Appliance Co, 89 Broad St, Boston, Mass.
Bigelow-Liptak Corp, 2840 W Grand Blvd, Detroit, Mich.
Brooklyn Fire Brick Works, 88 Van Dyke St, Brooklyn, N. Y.
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Adv pages 48, 49
Laclede-Christy Clay Products Co, 411 N 7th, St. Louis, Mo.
Louisville Fire Brick Works, Inc, Louisville, Ky.
McLeod & Henry Co, Inc, 31 Monroe St, Troy, N. Y.
Mexico Refractories Co, Mexico, Mo.
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Adv pages 181, 232, 254c
Quigley Co, 56 W 45th St, New York, N. Y.
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Acme Boiler Co, Fort Worth, Texas
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Carborundum Co, Dept P, Perth Amboy, N. J.
Chicago Fire Brick Co, 1463 Elston Ave, Chicago, Ill.
Ehret Magnesia Mfg Co, Inc, Valley Forge, Pa.
Adv pages 50, 51
Green, A P, Fire Brick Co, 1020 Breckenridge, Mexico, Mo.
Harbison-Walker Refractories Co, 1800 Farmers Bank Bldg, Pittsburgh, Pa.
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Laclede-Christy Clay Products Co, 411 N 7th Street, St Louis Mo.
Mexico Refractories Co, Mexico, Mo.
Plibrico Jointless Firebrick Co, 1818 Kingsbury St, Chicago, Ill.
Adv pages 181, 232, 254c
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(See Coolers, Brine)

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Adv page 275
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
National Carbon Co, Carbon Sales Div, Cleveland, Ohio
Ohio Carbon Co, Cleveland, Ohio
Speer Carbon Co, 40 Theresia St, Saint Marys, Pa.
U. S. Graphite Co, Holland Ave, Saginaw, Mich.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv page 54, 55

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Erie City Iron Works, 1422 East Ave, Erie, Pa.
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Frederick Iron & Steel Co, Frederick, Md.
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Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Hahn Engrg Div, 233 Broadway, New York, N. Y.
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Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Link-Belt Co, 300 W Pershing Road, Chicago, Ill.
Adv page 3
Michelman Steel Construction Co, Quincy, Ill.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Stearns-Roger Mfg Co, Denver, Colo.
Stephens-Adamson Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
United Conveyor Corp, Dearborn & Van Buren Sts, Chicago, Ill.

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Anthony Co, 47-33 5th St, Long Island City, N. Y.
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Adv page 185
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Combustion Equipment Co, 1820 Cherry St, Kansas City, Mo.
Coppus Engrg Corp, 350 Park Ave, Worcester, Mass.
Denver Fire Clay Co, 2301 Blake St, Denver, Colo.
Eclipse Fuel Engrg Co, 707 S Main St, Rockford, Ill.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
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Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Mahr Mfg Co, Minneapolis, Minn.
National Airoil Burner Co, 1284 E Sedgley Ave, Philadelphia, Pa.
Natural Gas Equipment, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Peabody Engrg Corp, 580 5th Ave, New York, N. Y.
Adv page 140
Ray Oil Burner Co, 401 Bernal Ave, San Francisco, Calif.
Staples & Pfeiffer Ltd, 528 Bryant St, San Francisco, Cal.
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Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Best, W N, Engrg Co, 90 West St, New York, N. Y.
Adv page 185
Coen Co, 40 Boardman Place, San Francisco, Calif.
Combustion Equipment Co, 1820 Cherry St, Kansas City, Mo.
Coppus Engineering Corp, 350 Park Ave, Worcester, Mass.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Johnson, S T, Co, Oakland, Calif.
Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Natural Gas Equipment, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Peabody Engrg Corp, 580 5th Ave, New York, N. Y.
Adv page 140
Ray Oil Burner Co, 401 Bernal Ave, San Francisco, Calif.
Rockwell, W S, Co, 50 Church St, New York, N. Y.
Adv page 148
Staples & Pfeiffer Ltd, 528 Bryant St, San Francisco, Cal.
Steam & Combustion Co, Racine, Wis.
Surface Combustion Corp, Sieloff St, Toledo, Ohio
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Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Best, W N, Engrg Co, 90 West St, New York, N. Y.
Adv page 185
Cashin, W D Co, 69 A St, Boston, Mass.
Chicago Flexible Shaft Co, Chicago, Ill.
Coen Co, 40 Boardman Place, San Francisco, Calif.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Combustion Equipment Co, 1820 Cherry St, Kansas City, Mo.
Denver Fire Clay Co, 2301 Blake St, Denver, Colo.
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Adv pages 144, 148
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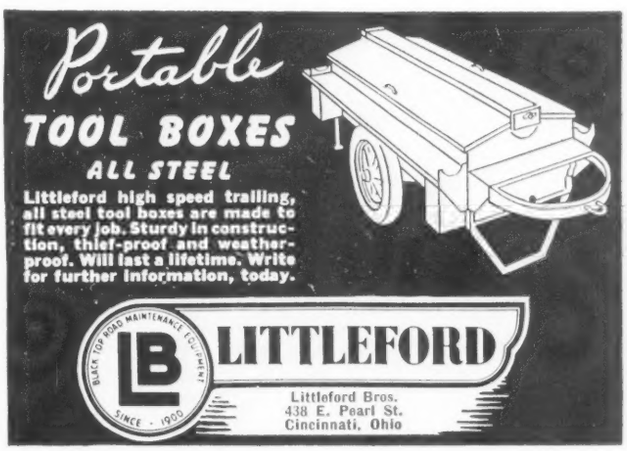
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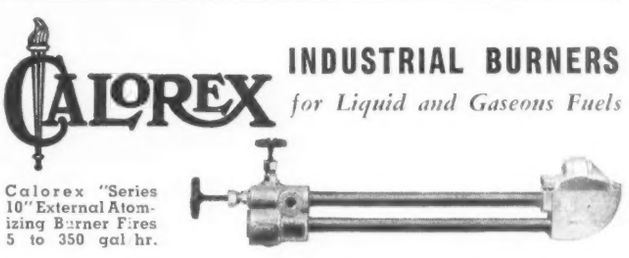
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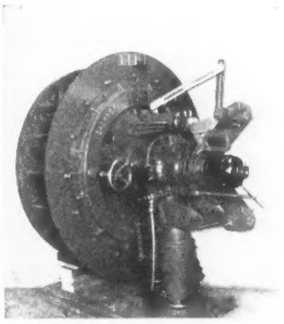

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Adv pages 90, 91
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Adv pages 4, 5, 6, 7, 34
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Adv pages 38, 39
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(See Brushes, Motor, Gen)

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Adv pages 46, 47

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Adv pages 180, 186, 217
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Adv pages 48, 49
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Adv pages 181, 232, 254c
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Adv pages 4, 5, 6, 7, 34
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Adv page 232
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Adv pages 48, 49
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McLeod & Henry Co, Inc, 31 Monroe St, Troy, N. Y.
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National Engrg Products Co, Commerce & Savings Bldg, Washington, D. C.
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Adv pages 181, 232, 254c
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Boston Gear Works, Inc, North Quincy, Mass.
Bridgeport Chain & Mfg Co, Bridgeport, Conn.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Continental Gin Co, 4500 Fifth Ave S, Birmingham, Ala.
Cullman Wheel Co, 1344 Altgeld St, Chicago, Ill.
Diamond Chain & Mfg Co, 444 Kentucky Ave, Indianapolis.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Link-Belt Co, 220 S Belmont Ave, Indianapolis, Ind.
Adv page 3
Medart Co, 3548 DeKalb St, St. Louis, Mo.
Morse Chain Co, Ithaca, N. Y.
Adv page 170
Murray, D J, Mfg Co, Wausau, Wis.
Philadelphia Gear Works, Erie Ave & G St, Philadelphia, Pa.
Adv page 175
Ramsey Chain Co, Inc, 1010 Broadway, Albany, N. Y.
Robinson Mfg Co, Muncy, Pa.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Union Chain & Mfg Co, Sandusky, Ohio.
Watson-Flagg Machine Co, 833-863 E 25th St, Paterson, N. J.
Webster Mfg Inc, Tiffin, Ohio

CHECK VALVES

(See Valves, Check)

CHEMICAL FEEDERS

(See Feeders, Chemical and Pumps, Proportioning)

CHILL RINGS

(See Rings, Chill)

CHILLERS, WATER, AIR CONDITIONING

Air & Refrigeration Corp, New York, N. Y.
Hall Mfg Co, Cedar Rapids, Iowa
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Richmond Engrg Co, 7th and Hospital Sts, Richmond, Va.
Stearns-Roger Mfg Co, Denver, Colo.
Trico Fuse Mfg Co, 2955 N 5th St, Milwaukee, Wis.
Vilter Mfg Co, 2217 S First St, Milwaukee, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Mach Corp, York, Pa.

CHIMNEYS, BRICK, CONCRETE

(See Also Stacks)
American Chimney Corp, 147 4th Ave, New York, N. Y.
Continental Chimney Co, 127 N Dearborn St, Chicago, Ill.
Custodis, Alphons, Chimney Construction Co, 80 Broad St, New York, N. Y.
Cutshall, J M, & Sons, Brazil, Ind.
Stearns-Roger Mfg Co, Denver, Colo.
Summerhays, Wm, Sons Corp, Rochester, N. Y.
Weber Chimney Co, 332 S Michigan Ave, Chicago, Ill.

CIRCUIT BREAKERS

(See Breakers, Circuit)

CLAMPS, PIPE

Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Diamond Expansion Bolt Co, Garwood, N. J.
Gaso Pump & Burner Mfg Co, Tulsa, Okla.
Jarecki Mfg Co, Erie, Pa.
Limbert, Geo B & Co, 570 Fulton St, Chicago, Ill.
Mueller Co, Decatur, Ill.
Smooth-On Mfg Co, D-30, 572 Communipaw, Jersey City, N. J.
Stearns-Roger Mfg Co, Denver, Colo.
Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.
Adv pages 103, 217, 222, 252 254d

CLEANERS, BOILER-TUBE

Airetool Mfg Co, 308 S Center St, Springfield, Ohio
Boiler Equipment Trust, North Amherst, Mass.
Elliott Co, Springfield, Ohio
Adv pages 8, 9
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Huyette, Paul B, Co, 403 N Broad St, Philadelphia, Pa.
Adv page 138
Jarecki Mfg Co, Erie, Pa.
Oakite Products Inc, 23 Thames St, New York, N. Y.
Pierce, Wm B, Co, Caxton Bldg, Buffalo, N. Y.
Perfection Grate & Stoker Co, Springfield, Mass.
Pilley Brush Co, Fort Madison, Iowa
Roto Co, 145 Sussex Ave, Newark, N. J.
Adv page 163
Spencer Turbine Co, 488 New Park Ave, Hartford, Conn.
Wilson, Thomas C, Inc, 47-28 37th St, Long Island City, N. Y.
Adv page 121

CLEANERS, HEAT-EXCHANGER, TUBE

Airetool Mfg Co, 308 S Center St, Springfield, Ohio
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Elliott Co, Springfield, Ohio
Adv pages 8, 9
Franklin Development Co, Drexel Bldg, Philadelphia, Pa.
Oakite Products Inc, 23 Thames St, New York, N. Y.
Robinson, John R, 354 W 31st St, New York, N. Y.
Roto Co, 145 Sussex Ave, Newark, N. J.
Adv page 163
Wilson, Thomas C, Inc, 47-28 37th St, Long Island City, N. Y.
Adv page 121

CLEANING SYSTEMS, VACUUM

Allen Billmyre Corp, Daily News Bldg, New York, N. Y.
Boiler Equipment Trust, North Amherst, Mass.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Breuer Electric Mfg Co, 5100 N Ravenswood Ave, Chicago, Ill.
Holly Pneumatic Systems, Dept 15, 15 E 40th St, New York, N. Y.
National Super Service Co, 1946 N 13th St, Toledo, Ohio
Roots-Connersville Blower Corp, Connersville, Ind.
Spencer Turbine Co, 488 New Park Ave, Hartford, Conn.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
United Conveyor Corp, 37 W Van Buren St, Chicago, Ill.
U. S. Hoffman Machinery Corp, 105 4th Ave, New York, N. Y.

CLOCKS, PROGRAM

(See Controllers, Time-Cycle)

CLOTH, ASBESTOS

(See Asbestos Products)

CLUTCHES, AUTOMATIC

American Clutch Equipment Co, Clifton, N. J.
Dawes Equipment, Inc, 2280 Penobscot Bldg, Detroit, Mich.
Diamond Iron Works Inc, Minneapolis, Minn.
Fast, Gustav, Engrg Co, Annapolis, Md.
Hilliard Corp, 4 W 4th St, Elmira, N. Y.
Madden, J P, Bethlehem, Pa.
Washburn Shops, Worcester, Mass.

CLUTCHES, FRICTION

Brown Engineering Co, 119 E 3rd St, Reading, Pa.
Caldwell, W E, Co, Inc, 280 Brandeis St, Louisville, Ky.
Carlyle Johnson Machine Co, 52 Main St, Manchester, Conn.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Chicago Pulley & Shafting Co, Chicago, Ill.
Conway Clutch Co, Cincinnati, O.
Dodge Mfg Corp, Mishawaka, Ind.
Falls Clutch & Machinery Co, Cuyahoga Falls, Ohio.
Foote Bros Gear & Machine Co, Western Blvd, Chicago, Ill.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio
Hilliard Corp, 4 W 4th St, Elmira, N. Y.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Johnson, Carlyle, Machine Co, 52½ Main St, Manchester, Conn.
Jones, W A, Foundry & Machine Co, 4423 W Roosevelt Rd, Chicago, Ill.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.
Link-Belt Co, 300 W Pershing Road, Chicago, Ill.
Adv page 3
McMahon & Co, Worcester, Mass.
Medart Co, 3548 DeKalb St, St. Louis, Mo.
Moore & White Co, Philadelphia, Pa.
Morse Chain Co, Ithaca, N. Y.
Adv page 170
Murray, D J, Mfg Co, Wausau, Wis.
Ramsey Chain Co, Inc, 1010 Broadway, Albany, N. Y.
Rockford Drilling Machine Div, Borg-Warner Corp, 114 Catherine St, Rockford, Ill.
St Regis Paper Co, Engrg & Mach Div, Mitchell St, Oswego, N. Y.
Spicer Mfg Corp, Toledo, Ohio.
Sprout, Waldron & Co, Muncy, Pa.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Twin Disc Clutch Co, Racine, Wis.
Watson-Flagg Machine Co, Paterson, N. J.
Weber Engine Co, 12th & Winchester Sts, Kansas City, Mo.
Webster Mfg, Inc, Tiffin, Ohio
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

CLUTCHES, MAGNETIC

Cutler-Hammer, Inc, 606 N 12th St, Milwaukee, Wis.
Adv page 101
Dings Magnetic Separator Co, Milwaukee, Wis.
Stearns Magnetic Mfg Co, 657 S 28th St, Milwaukee, Wis.
Universal Gear Corp, 1452 E 19th St, Indianapolis, Ind.

CLUTCHES, OVERRUNNING

Hilliard Corp, 4 W 4th St, Elmira, N. Y.
Morse Chain Co, Ithaca, N. Y.
Adv page 170

COAL

Appalachian Coals, Inc, Cincinnati, Ohio.
Berwind-White Coal Mining Co, 1 Broadway, New York, N. Y.
Chesapeake & Ohio Railway, Terminal Tower, Cleveland, Ohio.
Adv page 137

WASTE DISPOSAL

. . . Industrial — Municipal

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W. H. & L. D. BETZ
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TULSA, OKLA. Thompson Bldg.
ST. LOUIS, MO. Paul Brown Bldg.
CINCINNATI, OHIO Temple Bar Bldg.
IN CANADA: Betz Laboratories Division of Wood Industries Supply Co., Ltd., Royal Bank Bldg., MONTREAL, QUE. • TORONTO, ONT., New Wellington Bldg.

Consolidation Coal Co, 30 Rockefeller Plaza, New York, N. Y.
General Coal Co, 2500 Fidelity-Philadelphia Trust Bldg, Philadelphia, Pa.
Adv page 258
Koppers Coal Co, Pittsburgh, Pa.
North American Coal Corp, Cleveland, Ohio
Peale, Peacock & Kerr, 420 Lexington Ave, New York, N. Y.
Pennsylvania Coal & Coke Corp, 70 E 45th St, New York, N. Y.
Pittsburgh Coal Co, Pittsburgh, Pa.
Adv page 278
Valley Camp Coal Co, Western Reserve Bldg, Cleveland, Ohio.

COAL METERS

(See Meters, Coal)

COATINGS, BOILER-DRUM AND TUBE

Dampney Co of America, 1243 River St, Hyde Park, Mass.
Huyette, Paul B, Co, Inc, 403 N Broad St, Phila, Pa.
Adv page 138

COATINGS, HEAT-, CORROSION-RESISTANT

Acheson Colloids Corp, 3000 Washington Ave, Port Huron, Mich.
Cheesman-Elliot Co, 647 Kent Ave, Brooklyn, New York
Dampney Co of America, 1243 River St, Hyde Park, Mass.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Inertol Co, 470 Frelinghuysen Ave, Newark, N. J.
Metallizing Engrg Co, 21-07 41st St, Long Island City, N. Y.
Monsanto Chemical Co, St Louis, Mo.
Pennsylvania Salt Mfg Co, 1000 Widener Bldg, Phila, Pa.
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Philadelphia Quartz Co, 121-24 S 3rd St, Philadelphia, Pa.
Quigley Co, 56 W 45th St, New York, N. Y.
Thurmalox Co, 3109 N Broad St, Philadelphia, Pa.
Wailes Dove-Hermiston Corp, Westfield, N. J.

COILS, PIPE, TUBING

California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Chase Brass & Copper, 236 Grand St, Waterbury, Conn.
Clow, James B, & Sons, 201-299 N Talman Ave, Chicago, Ill.
Corning Glass Works, Dept IP, Corning, N. Y.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Duriron Co, Inc, Dayton, Ohio.
General Refrigeration Div, Yates-American Mach Co, Beloit, Wis.
Grinnell Co, 277 W Exchange St, Providence, R. I.
Adv page 141
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Hamilton Copper & Brass Works, Hamilton, Ohio.
Harris, Arthur & Co, 212 N Aberdeen St, Chicago, Ill.
Harrisburg Steel Corp, Harrisburg, Pa.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Keating, E F, Pipe Bending Co, Inc, Hartford, Conn.
Limbert, Geo B, & Co, 570 Fulton St, Chicago, Ill.
Marlo Coil Co, St Louis, Mo.
Midwest Piping & Supply Co, 1450 S 2nd St, St Louis, Mo.
National Pipe Bending Co, New Haven, Conn.
National Valve & Mfg Co, 3102 Liberty Ave, Pittsburgh, Pa.
Adv page 271
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio.
Pittsburgh Pipe Coil & Bending Co, Pittsburgh, Pa.
Pittsburgh Piping & Equipt Co, 12 43rd St, Pittsburgh, Pa.
Adv page 169
Power Piping Div, Blaw-Knox Co, 1525 Pennsylvania Ave, Blawnox, Pa.
Rempe Co, 340 N Sacramento Blvd, Chicago, Ill.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Shaw, B F, Co, 509 E 2nd St, Wilmington, Del.
Adv page 123
Stearns-Roger Mfg Co, Denver, Colo.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Wolverine Tube Co, Detroit, Mich.
Zallea Bros & Johnson, 820 Locust St, Wilmington, Del.

COILS, REFRIGERATING

Baker Ice Machine Co, Inc, Omaha, Neb.
California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Chase Brass & Copper, 236 Grand St, Waterbury, Conn.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Machy Co, Riverside Ave, Spokane, Wash.
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Harrisburg Steel Corp, Harrisburg, Pa.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Keating, E F, Pipe Bending Co, Inc, Hartford, Conn.
Kennart, Sam, Inc, 3333 Market St, St Louis, Mo.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St Louis, Mo.
Midwest Piping & Supply Co, 1450 S 2nd St, St Louis, Mo.
Mueller Brass Co, 1925-A Lapeer Ave, Pt Huron, Mich.
National Pipe Bending Co, New Haven, Conn.
Niagara Blower Corp, 6 E 45th St, New York, N. Y.
Peerless of America, Inc, Marion, Ind.
Pittsburgh Pipe Coil & Bending Co, Pittsburgh, Pa.
Rempe Co, 340 N Sacramento Blvd, Chicago, Ill.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Stearns-Roger Mfg Co, Denver, Colo.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Typhoon Air Conditioning Co, 252 W 26th St, New York, N. Y.
Vesterdahl, Karl, & Co, 90 West St, New York, N. Y.
Vilter Mfg. Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Wolverine Tube Co, Detroit, Mich.
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machry Corp, York, Pa.

COLD-STORAGE PLANTS

Baker Ice Machine Co, Inc, Omaha, Neb.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Machinery Co, Spokane, Wash.
General Refrigeration Div, Yates-American Mach Co, Beloit, Wis.
Stearns-Roger Mfg Co, Denver, Colo.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machry Corp, York, Pa.

COLLECTORS, DUST

Allen Billmyre Corp, Daily News Bldg, New York, N. Y.
American Air Filter Co, Louisville, Ky.
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Foundry Equipment Co, Mishawaka, Ind.
Bartlett & Snow, C O, Co, Cleveland, Ohio
Brady Conveyors Corp, 20 W Jackson Ave, Chicago, Ill.
Bubar, Hudson H, 15 Park Row, New York, N. Y.
Buell Engrg Co, 70 Pine St, New York, N. Y.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Diamond Power Specialty Corp, Box 288, Detroit, Mich.
Adv pages 12-13
Dracco Corp, 4083 E 116th St, Cleveland, Ohio.
Engineering Specialties Co, 39 Cortlandt St, New York, N. Y.
Garden City Fan Co, 332 S Michigan Ave, Chicago, Ill.
Grand Rapids Blow Pipe & Dust Arrester Co, Grand Rapids, Mich.
Holly Pneumatic Systems, Inc, Dept 15, 15 E 40th St, New York, N. Y.
Kirk & Blum Mfg Co, 2831 Spring Grove Ave, Cincinnati, Ohio.
Pangborn Corp, 90 Pangborn Blvd, Hagerstown, Md.
Peabody Engrg Corp, 580 5th Ave, New York, N. Y.
Adv page 140
Pease, Anthony, Equipt Co, 30 Charles River Rd, Cambridge, Mass.
Prat-Daniel Corp, 80 S Water St, Port Chester, N. Y.
Adv page 257
Savage, W J, Co, Knoxville, Tenn.
Skinner Heating & Ventilating Co, 1990 N 9th, St. Louis, Mo.
Sly, W W, Mfg Co, Cleveland, O.
Spencer Turbine Co, 488 New Park Ave, Hartford, Conn.
Staynew Filter Corp, Rochester, N. Y.
Sterling Blower Co, 791 Windsor St, Hartford, Conn.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Tabor Mfg Co, Tacony St, Philadelphia, Pa.
U S Hoffman Machy Corp, 105 4th Ave, New York, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

COLLECTORS, FLYASH

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Bubar, Hudson H, 15 Park Row, New York, N. Y.
Buell Engrg Co, Inc, 70 Pine St, New York, N. Y.
Green Fuel Economizer Co, 637 Main St, Beacon, N. Y.
Adv pages 24, 25
Prat-Daniel Corp, 80 S Water St, Port Chester, N. Y.
Adv page 257
Research Corp, 405 Lexington Ave, New York, N. Y.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Western Precipitation Corp, 1016 W 9th, Los Angeles, Cal.

COLUMNS, WATER

(See Water Columns)

COMBUSTION CONTROL

(See Control Systems, Combustion)

COMPOUNDS, CONCRETE, RESURFACING

Feedwaters Inc, 140 Cedar St, New York, N. Y.
Flexrock Co, 23rd & Manning Sts, Philadelphia, Pa.
Adv page 150
Truscon Laboratories, Detroit, Mich.

COMPOUNDS, GREASE-REMOVING

Barrett Co, 40 Rector St, New York, N. Y.

CONSULTATION

. . . On All Water Treatment Problems

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CINCINNATI, OHIO Temple Bar Bldg.

IN CANADA: Betz Laboratories Division of Wood Industries Supply Co., Ltd., Royal Bank Bldg., MONTREAL, QUE. • TORONTO, ONT., New Wellington Bldg.

Detroit Rex Products Co, Hillview & Sorrento Aves, Detroit, Mich.
du Pont de Nemours, E I, & Co, Wilmington, Del.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Oakite Products Inc, 23 Thames St, New York, N. Y.
Pennsylvania Salt Mfg Co, 1000 Widener Bldg, Philadelphia, Pa.
Philadelphia Quartz Co, 121-124 S 3rd St, Philadelphia, Pa.
Plouff Co, 1151 Columbus Ave, Boston, Mass.
Quigley Co, 56 W 45th St, New York, N. Y.
Standard Oil of Calif, 225 Bush St, San Francisco, Calif.

COMPOUNDS, PIPE-JOINT

Acheson Colloids Corp, 3000 Washington Ave, Pt Huron Mich.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Crane Packing Co, 1801 Cuyler Ave, Chicago, Ill.
Dixon, Joseph, Crucible Co, 170 Wayne St, Jersey City, N. J.
Adv page 272
Garlock Packing Co, 400 Main St, Palmyra, N. Y.
Adv page 135
Grinnell Co, Inc, 277 W Exchange St, Providence, R. I.
Adv page 141
Ilsley, Doubleday & Co, 56-14 Nurge Ave, Maspeth, N. Y.
Key Co, Alta Sita, East St Louis, Ill.
Keystone Lubricating Co, Clearfield & Lippincott Sts, Philadelphia, Pa.
National Engineering Products, Inc, Commerce & Savings Bldg, Washington, D. C.
Plouff Co, 1151 Columbus Ave, Boston, Mass.
Preferred Utilities Mfg Corp, New York, N. Y.
Quigley Co, 56 W 45th St, New York, N. Y.
Rockwood Sprinkler Co, 54 Harlow St, Worcester, Mass.
Smooth-On Mfg Co, D-30, 572 Communipaw Ave, Jersey City, N. J.
Standard Oil Co, Ind., 910 S Michigan Ave, Chicago, Ill.
U. S. Graphite Co, Holland Ave, Saginaw, Mich.
X-Pando Corp, 43–15 36th St, Long Island City, N. Y.

COMPOUNDS, RUST-PREVENTING

Adkins, Young & Allen Co, S Jefferson St, Chicago, Ill.
American Sand-Banum Co, Dept MP, 9 Rockefeller Plaza, New York, N. Y.
Adv page 255
Barrett Co, 40 Rector St, New York, N. Y.
Calgon Inc, 300 Ross St, Pittsburgh, Pa.
Chemical Solvent Co, Box 487, Birmingham, Ala.
Dampney Co of America, 1243 River St, Hyde Park, Mass.
Dearborn Chemical Co, 310 South Michigan Ave, Chicago, Ill.
Dixon, Joseph, Crucible Co, 170 Wayne St, Jersey City, N. J.
Adv page 272
Feedwaters Inc, 140 Cedar St, New York, N. Y.
Flintkote Co, 30 Rockefeller Plaza, New York, N. Y.
Franklin Oil & Gas Co, Bedford, Ohio
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Houghton, E F, & Co, 244–50 W Somerset St, Philadelphia, Pa.
Inertol Co, Inc, 470 Frelinghuysen Ave, Newark, N. J.
Keystone Lubricating Co, Clearfield & Lippincott Sts, Philadelphia, Pa.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Monsanto Chemical Co, St. Louis, Mo.
North American Fibre Products Co, Cleveland, Ohio
Oakite Products Inc, 23 Thames St, New York, N. Y.
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Philadelphia Quartz Co, 121 S 3rd St, Philadelphia, Pa.

Look for the noun in the product listing, for example:
"Conduit, Electrical"
not
"Electrical Conduit"

Rustvoid Products Inc, 30-30 Northern Blvd, Long Island City, N. Y.
Socony - Vacuum Oil Co, 26 Broadway, New York, N. Y.
Standard Oil Co, Ind., 910 S Michigan Ave, Chicago, Ill.
Standard Oil Co, of N. J., 26 Broadway, New York, N. Y.
Wailes Dove-Hermiston Corp, Westfield, N. J.
Western Chemical Co, 714 Washington, Kansas City, Mo.
Whiting Leather & Belting Co, Long Island City, N. Y.

COMPOUNDS, SCALE-, RUST-REMOVING

American Sand-Banum Co, Dept MP, 9 Rockefeller Plaza, New York, N. Y.
Adv page 255
Calgon, Inc, 300 Ross St, Pittsburgh, Pa.
Chemical Solvent Co, Box 487, Birmingham, Ala.
Dearborn Chemical Co, 310 South Michigan Ave, Chicago, Ill.
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
Adv page 238
Feedwaters, Inc, 140 Cedar St, New York, N. Y.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
McVicker, W B, Co, Douglass St, Brooklyn, N. Y.
North American Fibre Prod Co, Cleveland, Ohio
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Plouff Co, 1151 Columbus Ave, Boston, Mass.
Oakite Products, Inc, 23 Thames St, New York, N. Y.
Rustvoid Products Inc, 30-30 Northern Blvd, Long Island City, N. Y.
Thurmalox Co, 3109 N Broad St, Philadelphia, Pa.
Water Treatment Co of America, 1159 Hodgkiss St, Pittsburgh, Pa.
Adv page 136
Western Chemical Co, 714 Washington, Kansas City, Mo.

COMPOUNDS, SLUSHING

Borne-Scrymser Co, 632 S Front St, Elizabeth, N. J.
Franklin Oil & Gas Co, Bedford, Ohio
Harris, A W, Oil Co, Box 1295, Providence, R. I.
Houghton, E F, & Co, 244-50 W Somerset St, Philadelphia, Pa.
Ilsley, Doubleday & Co, 56-14 Nurge Ave, Maspeth, N. Y.
Ironsides Co, Columbus, Ohio.
Plouff Co, 1151 Columbus Ave, Boston, Mass.
Socony - Vacuum Oil Co, 26 Broadway, New York, N. Y.
Standard Oil Co, Ind., 910 S Michigan Ave, Chicago, Ill.
Swan-Finch Oil Corp, RCA Bldg West, New York, N. Y.
Warren Bros Roads Co, Cambridge, Mass.

COMPOUNDS, WATERPROOFING

Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.
Adv pages 180, 186, 217
Barrett Co, 40 Rector St, New York, N. Y.
Dearborn Chemical Co, 310 S Michigan Ave, Chicago, Ill.
du Pont de Nemours, E I, & Co, Wilmington, Del.
Flexrock Co, 23rd & Manning Sts, Philadelphia, Pa.
Adv page 150
Flintkote Co, 30 Rockefeller Plaza, New York, N. Y.
Halowax Co, 30 East 42nd St, New York, N. Y.
Inertol Co, 470 Frelinghuysen Ave, Newark, N. J.
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Koppers Co, Pittsburgh, Pa.
North American Fibre Products Co, Cleveland, Ohio
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Plibrico Jointless Firebrick Co, 1818 Kingsbury St, Chicago, Ill.
Adv pages 181, 232, 254c
Smooth-On Mfg Co, D-30, 572 Communipaw Ave, Jersey City, N. J.
Socony - Vacuum Oil Co, 26 Broadway, New York, N. Y.
Sonneborn, L, Sons, Inc, 88 Lexington Ave, New York, N. Y.
Standard Oil of Calif, 225 Bush St, San Francisco, Calif.
Toch Bros, Inc, 2600 Richmond Terrace, Staten Island, New York
Tropical Paint & Oil Co, Cleveland, Ohio.
Truscon Labs, Detroit, Mich.
Wailes Dove-Hermiston Corp, Westfield, N. J.

COMPRESSOR VALVES

(See Valves, Pump & Compressor)

COMPRESSORS, AIR, GAS

Allen Billmyre Corp, Daily News Bldg, New York, N. Y.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American-Marsh Pumps, Inc, 60 Capitol Ave, N E, Battle Creek, Mich.
Beach-Russ Co, 50 Church St, New York, N. Y.
Brunner Mfg Co, 1821 Broad St, Utica, N. Y.
Bury Compressor Co, Erie, Pa.
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Clark Bros Co, Olean, N. Y.
Cooper-Bessemer Corp, Mount Vernon, Ohio.
Crowell Mfg Co, 319 Franklin Ave, Brooklyn, N. Y.
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St Louis, Mo.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
De Vilbiss Co, Toledo, Ohio
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Fuller Co, 111 Bridge St, Catasauqua, Pa.
Gardner-Denver Co, 100 Gardner Drive, Quincy, Ill.
Hardie-Tynes Mfg Co, Birmingham, Ala.
Hobart Bros Co, Troy, Ohio.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kraissl Co, Hackensack, N. J.
Le Roi Co, Milwaukee, Wis.
Mesta Machine Co, P O Box 1466, Pittsburgh, Pa.
Nash Engrg Co, S Norwalk, Conn.
National Steam Pump Co, Upper Sandusky, Ohio.
National Transit Pump & Machine Co, Oil City, Pa.
Nordberg Mfg Co, 3703 S Chase Ave, Milwaukee, Wis.
O K Clutch & Machinery Co, Columbia, Pa.
Oliver United Filters, Inc, Oakland, Calif.
Pennsylvania Pump & Compressor Co, Easton, Pa.
Quincy Compressor Co, Quincy, Ill.
Roots-Connersville Blower Corp, Connersville, Ind.
Schramm, Inc, West Chester, Pa.
Adv page 189
Spencer Turbine Co, 488 New Park Ave, Hartford, Conn.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Westinghouse Air Brake Co, Wilmerding, Pa.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Worthington Pump & Machinery Corp, Harrison, N. J.
Wright Mfg Div of American Chain & Cable Co, York, Pa.
Yeomans Bros Co, 1446 Dayton St, Chicago, Ill.
York Ice Machy Corp, York, Pa.

DELIVER AIR AT LOW COST
where you need it

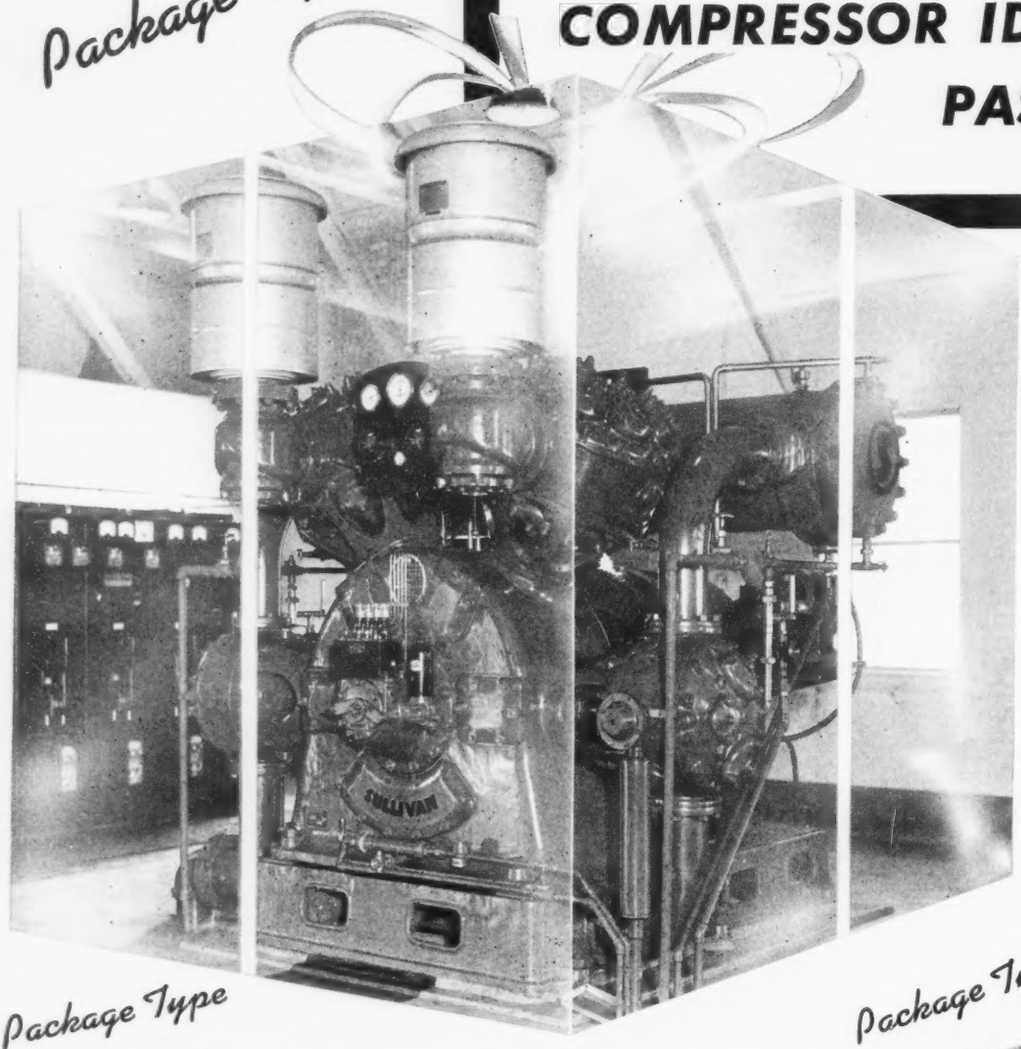
You save money by installing SCHRAMM air compressors. These modern units—correctly engineered and designed for high efficiency and low power consumption—can be placed in any convenient location. Vertical cylinders, cast en-bloc, insure a compact design using a minimum of floor space. Perfect balance eliminates the need for special foundations. Ability to install the unit close to the point where air is needed, reduces piping costs. Integral cooling saves water and insures uniform temperature for proper lubrication.

SCHRAMM, INC., West Chester, Pa.

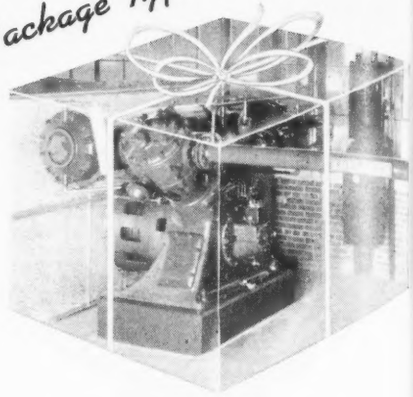
SCHRAMM
COMPRESSORS

THE GREATEST TIME, SPACE AND MONEY SAVING COMPRESSOR IDEA OF THE PAST DECADE . . .

Package Type

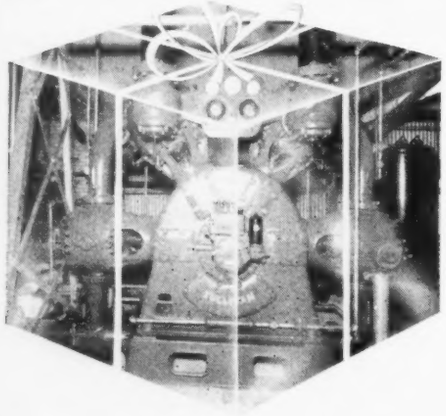


Package Type



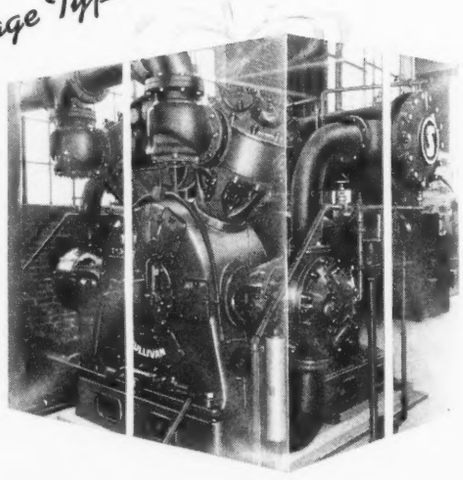
A WN-112 Two Cylinder Package Type Compressor in a smaller plant. Displacement from 378 to 1828 C.F.M. The largest two-cylinder Package Type Compressor requires a maximum space of 8 feet long and 6 feet 8 inches wide; foundation length 4 feet 2 inches; width 2 feet 11 inches.

Package Type



Here are three of the Sullivan WN-114 Four Cylinder Package Type Compressors installed in plants engaged in crucial defense manufacture. The WN-114 is made in four sizes, single or twin units. 175 to 600 h.p. From 1284 to 3656 C.F.M. Maximum space required for the largest WN-114 is 9 feet long, and 9 feet 8½ inches wide; maximum foundation space: length 7 feet 9 inches; width 5 feet 3 inches.

Package Type



SULLIVAN *Air* COMPRESSORS

SULLIVAN *Package Type* COMPRESSOR

Although the Sullivan Package Type Compressor has been fully proved in service, although it already has hundreds of enthusiastic users among leading industrials . . . it is so pat an answer to the crucial problem facing industry right now that it might have been devised only yesterday.

The Sullivan Package Type Compressor can best be described as "air in a hurry." It is delivered to your door complete and assembled, ready to set up. Many times it has been on the line 24 hours after its arrival. It is so compact it requires only half as much space as the old style, bulky compressor. It is so modern and perfectly balanced in construction that it requires only 1/5th or 1/6th the usual foundation of the older type compressor.

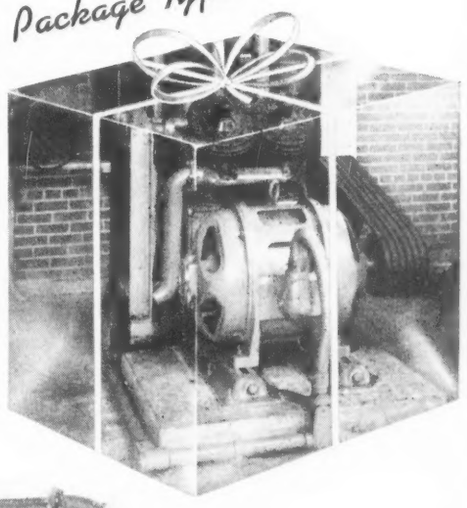
Moreover, it is made in capacities and operating characteristics to fit almost any need—from 378 up to 3656 cubic feet per minute.

It embodies the most modern ideas in compressor design, metallurgical science and machine techniques, thoroughly tested and thoroughly proven. No casting of less than 35,000 lbs. per square inch tensile strength is used in Package Type Compressors. Sullivan is the *only* compressor making such extensive use of modern high tensile alloys such as Hytenite, Meehanite and Mocasco.

Whatever your needs may be, you owe it to yourself to have a clear picture of the greatest money, time and space saving compressor idea of a decade—the Package Type Compressor. Write for descriptive bulletin A-38 or send your specifications.

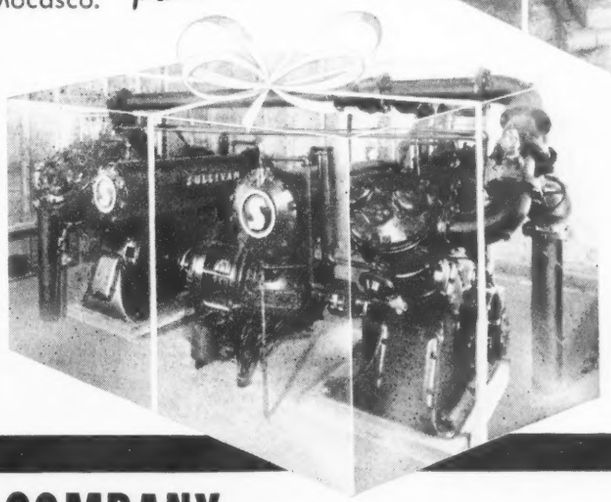
SULLIVAN PACKAGE TYPE Compressors are two-stage, double acting, long-lived, heavy duty, continuous service compressors—much smaller than old style compressors of the same capacity—and yet have operating economies equal to or exceeding those of the older bulky units of the same capacity. PACKAGE TYPE compressors need only to be hooked up to power, water and air lines and they are ready for 24-hour per day constant and efficient service. They are particularly suitable for synchronous motor drive and extremely well adapted for drive from steam turbines or diesel engines.

Package Type



The Unitair Package Type Compressor, smallest of this class of compressors. Two-stage, single-acting, air cooled. For small manufacturing plants, standby service and similar application. Overall dimensions, smallest size 2 ft. 11 in. x 3 ft. 8 in. Largest size 3 ft. 8 in. x 5 ft. Capacities from 107 C.F.M. to 438 C.F.M.

Package Type



Twin unit of the WN-112 Two Cylinder Package Type Compressor, both units being driven by the same synchronous motor.

ninetieth 90th ANNIVERSARY 1851 1941

SULLIVAN MACHINERY COMPANY *Executive Offices:* MICHIGAN CITY, INDIANA

FACTORIES: MICHIGAN CITY, IND. • CLAREMONT, N. H. • DUNDAS, ONT. • GRANTHAM, ENG.

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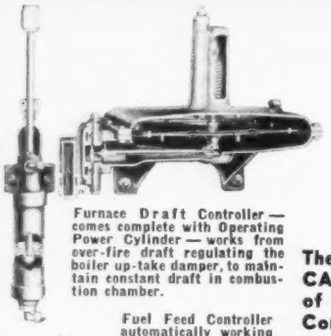
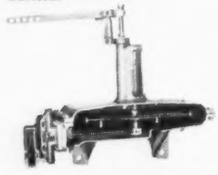
HEAVY DUTY, SINGLE OR TWO STAGE STATIONARY AIR COMPRESSORS IN ANGLE, V-VERTICAL, VERTICAL OR HORIZONTAL TYPES IN SIZES FROM ¼ TO 3000 H. P. ALSO A COMPLETE LINE OF PORTABLE COMPRESSORS

CASH STANDARD

AUTOMATIC COMBUSTION CONTROL

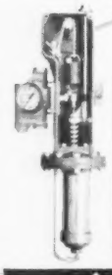


Air Flow Controller meters the air needed for combustion, keeping the air supply in step with fuel feed for good combustion.



Furnace Draft Controller — comes complete with Operating Power Cylinder — works from over-fire draft regulating the boiler up-take damper, to maintain constant draft in combustion chamber.

Fuel Feed Controller automatically working from boiler pressure will adjust the rate of combustion by regulating fuel supply.



Cash Standard SYSTEMS
—make worthwhile fuel bill cuts
—greatly reduce maintenance costs

There are numerous types of CASH STANDARD Systems of Automatic Combustion Control. They are varied according to the necessities of the plant requirements. Regardless of the kind of fuel you burn or the size or type of your boiler or furnace you can secure a dependable CASH STANDARD Automatic System that will give you the means to have a more profitably operating boiler room.

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DECATUR, ILLINOIS

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CONTROLS .. VALVES

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Therm-O-Tile Is the Simplest, Strongest, Most Efficient, and Only Truly Complete Conduit for Underground Pipe Lines

Unyielding monolithic concrete base. No broken stone fill. No bell joints. Build to correct grade with Therm-O-Tile and that grade will never change. Condensate pockets cannot form. Strong arched construction. Internal channel drain. Etc. For the numerous other reasons why Therm-O-Tile is by far the superior conduit system, ask for Bulletin 381.

Sold and installed by Johns-Manville Construction Units in all Principal Cities.

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H. W. Porter & Co., Inc., 827-P Frelinghuysen Ave., Newark, N. J.
Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Name .....
Firm .....
Street .....
City ..... State .....

COMPRESSORS, AIR, ENGINE STARTING

Cooper-Bessemer Corp, Mt Vernon, Ohio
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Novo Engine Co, 1 Porter St, Lansing, Mich.
Quincy Compressor Co, Quincy, Ill.
Schramm, Inc, West Chester, Pa.
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Yeomans Bros Co, 1446 N Dayton St, Chicago, Ill.

COMPRESSORS, REFRIGERATION

Baker Ice Machine Co, Inc, Omaha, Neb.
Brunner Mfg Co, 1821 Broad St, Utica, N. Y.
Carrier Corp, Syracuse, N. Y.
Clark Bros Co, Olean, N. Y.
Cooper-Bessemer Corp, Mt. Vernon, Ohio
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St. Louis, Mo.
Curtis Refrigerating Machine Co, St. Louis, Mo.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Machinery Co, Riverside Ave, Spokane, Wash.
General Refrigeration Div, Yates-American Mach Co, Beloit, Wis.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Vesterdahl, Karl, & Co, 90 West St, New York, N. Y.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Worthington Pump & Machinery Corp, Harrison, N. J.
Yeomans Bros Co, 1466 N Dayton St, Chicago, Ill.
York Ice Machy Corp, York, Pa.

CONDENSER REPAIRS

(See Repair Work, Condenser)

CONDENSER TUBES

(See Tubes, Condenser)

CONDENSERS, EVAPORATIVE

American Locomotive Corp, 30 Church St, New York, N. Y.
Adv pages 42, 172
Baker Ice Machine Co, Inc, Omaha, Neb.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Carrier Corp, Syracuse, N. Y.
Corning Glass Works, Dept IP, Corning, N. Y.
Curtis Refrigerating Machine Co, St. Louis, Mo.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Frick Co, 325 Broadway, Waynesboro, Pa.
General Refrigeration Div, Yates-American Mach Co, Beloit, Wis.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St. Louis, Mo.
New England Cooling Tower Co, 32 Cambridge St, Charlestown, Mass.
Adv page 244
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Rome Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Vilter Mfg Co, 2217 S First St, Milwaukee, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Worthington Pump & Machinery Co, Harrison, N. J.
York Ice Machy Corp, York, Pa.
Young Radiator Co, Racine, Wis.

CONDENSERS, JET, BAROMETRIC

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Locomotive Corp, 30 Church St, New York, N. Y.
Adv pages 42, 172
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Dean Brothers Co, Indianapolis, Ind.
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Ross Heater & Mfg Co, 1407 West Ave, Buffalo, N. Y.
Schubert-Christy Corp, 1600 Georgia St, Affton Station, St. Louis, Mo.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Struthers-Wells Titusville Corp, Warren, Pa.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.

CONDENSERS, REFRIGERATION

(See also Refrigerating Systems)
Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Alco Products Div, 36 Church St, New York, N. Y.
Adv page 172
Andale Co, 1600 Arch St, Philadelphia, Pa.
Baker Ice Machine Co, Inc, Omaha, Neb.
Carrier Corp, Syracuse, N. Y.
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St Louis, Mo.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Frick Co, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Machinery Co, Riverside Ave, Spokane, Wash.
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Lummus Co, 420 Lexington Ave, New York, N. Y.
McCord Radiator & Mfg Co, Detroit, Mich.
Rempe Co, 340 N Sacramento Blvd, Chicago, Ll.
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Stearns-Roger Mfg Co, Denver, Colo.
Struthers-Wells Titusville Corp, Warren Pa.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machinery Corp, York, Pa.

CONDENSERS, SURFACE

Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Braun, C F, & Co, 1000 S Fremont Ave, Alhambra, Calif.
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Elliott Co, Jeannette, Pa.
Adv pages 8, 9

Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Schubert-Christy Corp, 1600 Georgia St, St. Louis, Mo.
Stearns-Roger Mfg Co, Denver, Colo.
Struthers-Wells Titusville Corp, Warren, Pa.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.
Worthington Pump & Machinery Corp, Harrison, N. J.
Zallea Bros & Johnson, 820 Locust St, Wilmington, Del.

CONDUIT-BENDING MACHINES
(See Pipe-Bending Machines)

CONDUIT, ELECTRICAL
American Metal Hose Branch, Waterbury, Conn.
Adv page 115
Anaconda Wire & Cable Co, 25 Broadway, New York, N. Y.
Byers, A M, Co, Pittsburgh, Pa.
Adv page 56
Chase Brass & Copper, 236 Grand St, Waterbury, Conn.
Clayton Mark & Co, 1900 Dempster St, Evanston, Ill.
Adv page 250
Continental-Diamond Fibre Co, Dept 18, Newark, Del.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
National Electric Products Corp, Pittsburgh, Pa.
Steel & Tubes Div, Republic Steel Corp, 218 E 131st St, Cleveland, Ohio.
Adv page 173
Youngstown Sheet & Tube Co, Youngstown, Ohio.
Adv page 176

CONDUIT, STEAM, UNDERGROUND
American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
Byers, A M, Co, Pittsburgh, Pa.
Adv page 56
Ehret Magnesia Mfg. Co, Inc, Valley Forge, Pa.
Adv pages 50, 51
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Porter, H W, & Co, 825 Frelinghuysen Ave, Newark, N. J.
Adv page 192
Ric-wiL Co, 1563 Union Commerce Bldg, Cleveland, Ohio
Adv page 270

CONDUIT, WOOD
American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
Wyckoff Pipe & Creosoting Co, 522 5th Ave, New York, N. Y.

CONTROLS, SAFETY, GAS & OIL ENGINE
Bardco Mfg & Sales Co, 4031 Goodwin Ave, Los Angeles, Cal.
Edison, Thomas A, Inc, West Orange, N. J.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Penn Electric Switch Co, Goshen, Ind.

CONTROL SYSTEMS, AUTOMATIC, OIL & GAS ENGINE
Barber Colman Co, Rockford, Ill.
Bardco Mfg & Sales Co, 4031 Goodwin Ave, Los Angeles, Cal.
Cooper-Bessemer Corp, Mt. Vernon, Ohio
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36

CONTROL SYSTEMS, AIR CONDITIONING
Armstrong Heat Control Co, Portland, Ore.
Barber Colman Co, Rockford, Ill.
Bristol Co, Waterbury, Conn.
Edison, Thomas A, Inc, West Orange, N. J.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Johnson Service Co, 507 E Michigan St, Milwaukee, Wis.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, Minneapolis, Minn.
Parks-Cramer Co, Fitchburg, Mass.
Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Taylor Instrument Cos, 95 Ames St, Rochester, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Machy Corp, York, Pa.

CONTROL SYSTEMS, COMBUSTION
Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio.
Adv pages 26, 27
Bristol Co, Waterbury, Conn.
Brooke Engineering Co, 517 Wayne Ave, Philadelphia, Pa.

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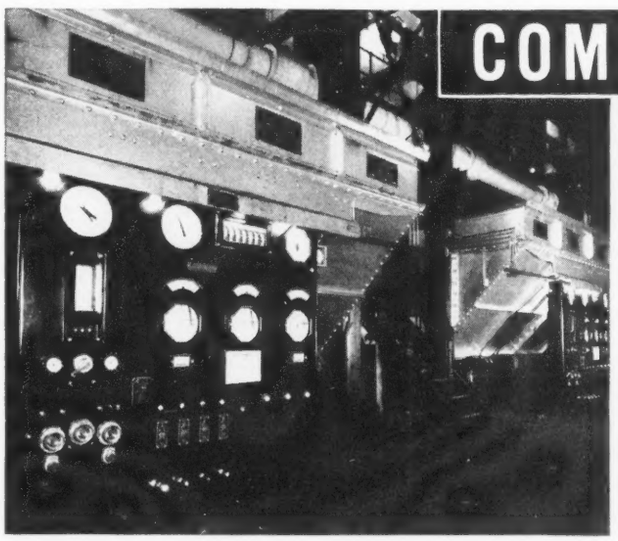

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CONSTANT STEAM PRESSURE
Automatically maintains a constant steam pressure by controlling the fuel and air input to the boilers in balance with the boiler load.

EFFICIENT COMBUSTION
Automatically maintains maximum combustion efficiency over entire range of boiler rating, by controlling simultaneously the fuel and air input to boiler in measured proportions and in a fixed ratio.

LOAD DISTRIBUTION
Automatically distributes load equally among all the boilers, or the load can be distributed between the boilers as desired.

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JACOB RUPPERT BREWING CO.	KREY PACKING CO.
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BEECHNUT PACKING CO.	U. S. NAVAL ACADEMY
TIMKEN ROLLER BEARING CO.	STEVENS HOTEL

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REPUBLIC FLOW METERS CO. 2222 DIVERSEY PKWY. CHICAGO, ILLINOIS

Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Cash, A W, Co, Decatur, Ill.
Adv pages 192, 235, 250, 253
Defender Automatic Regulator Co, St. Louis, Mo.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Regulator Corp, 165 Broadway, New York, N. Y.
General Controls Inc, 810 Allen Ave, Glendale, Calif.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Hays Corp, 905 8th St, Michigan City, Ind.
Adv page 195
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Johnson Service Co, 507 E Michigan Ave, Milwaukee, Wis.
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
Adv page 2d cover
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Shallcross Controls, Inc, 121 N Broadway, Milwaukee, Wis.
TeJax Engrg Corp, 2 Allens Ave, Providence, R. I.
Adv page 216
Weeks Merit System, Inc, 228 Aborn St, Providence, R. I.
Wing, L J, Mfg Co, W 14th St & 7th Ave, New York, N. Y.
Adv page 182

CONTROL SYSTEMS, HEAT, HOT-WATER, AUTOMATIC

Barber-Colman Co, Rockford, Ill.
Burling Instrument Co, 253 Springfield Ave., Newark, N. J.
Cleveland Steel Products Corp, Wellington, Ohio.
Detroit Lubricator Co, 5900 Trumbull Ave, Detroit, Mich.
Edison, Thomas A, Inc, West Orange, N. J.
Friez, Julien P. & Sons, Inc, Central Ave, Baltimore, Md.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Hoffman Specialty Co, 1001 York St, Minneapolis, Ind.
Illinois Engineering Co, Racine Ave & 21st St, Chicago, Ill.
Johnson Service Co, 507 E Michigan St, Milwaukee, Wis.
Marsh Tritrol Co, Chicago, Ill.
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Mueller Co, Decatur, Ill.
Penn Electric Switch Co, Goshen, Ind.
Photoswitch Inc, 21 Chestnut St, Cambridge, Mass.
Powers Regulator Co, 2815 Greenview Ave, Chicago, Ill.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Sterling Inc, Milwaukee, Wis.
Taylor Instrument Cos, Rochester, N. Y.

CONTROL SYSTEMS, HEATING, STEAM

Armstrong Heat Control Co, Portland, Ore.
Barber Colman Co, Rockford, Ill.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Edison, Thomas A, Inc, West Orange, N. J.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, Div, 4 N Central Ave, Baltimore, Md.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Johnson Service Co, 507 E Michigan St, Milwaukee, Wis.
Marsh Tritrol Co, Chicago, Ill.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Penn Electric Switch Co, Goshen, Ind.
Photoswitch, Inc, 21 Chestnut St, Cambridge, Mass.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Sterling, Inc, Milwaukee, Wis.
Taylor Instrument Cos, 95 Ames St, Rochester, N. Y.
Warren Webster & Co, Camden, N. J.
Adv page 247

CONTROLLERS, ELECTRICAL

(See Also Regulators)
Allen-Bradley Co, Milwaukee, Wis.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Elevator & Machine Co, Louisville, Ky.
Arrow-Hart & Hegeman Elec Co, 105 Hawthorne St, Hartford, Conn.
Barber Colman Co, Rockford, Ill.
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Clark Controller Co, Cleveland, Ohio
Cutler-Hammer Inc, 606 N 12th St, Milwaukee, Wis.
Adv page 101
Electric Controller & Mfg Co, Cleveland, Ohio
Esterline-Angus Co, P O Box 596, Indianapolis, Ind.
General Controls Co, 810 Allen Ave, Glendale, Calif.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Regulator Corp, 165 Broadway, New York, N. Y.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
Adv page 2nd cover
Manning, Maxwell & Moore, Bridgeport, Conn.
Monitor Controller Co, Lombard & Gay Sts, Baltimore, Md.
Penn Electric Switch Co, Goshen, Ind.
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Square D Co, Rivard & Piquette Sts, Detroit, Mich.
Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Ward Leonard Electric Co, 31 South St, Mt Vernon, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheelco Instruments Co, 1929 S Halstead St, Chicago, Ill.
Adv page 243
Zenith Electric Co, 845 So Wabash Ave, Chicago, Ill.

CONTROLLERS, TIME-CYCLE

Autocall Co, Shelby, Ohio
Automatic Temperature Control Co, Germantown Ave & Logan St, Philadelphia, Pa.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio.
Adv pages 26, 27
Barber Colman Co, Rockford, Ill.
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Mason-Neilon Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Marsh Tritrol Co, Chicago, Ill.
Photoswitch Inc, 21 Chestnut St, Cambridge, Mass.
Tagliaube, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Westinghouse Electric & Mfg Co, Pittsburgh, Pa.
Adv pages 54, 55

CONVECTORS, HEATING

American Radiator & Std Sanitary Corp, 40 W 40th St, New York, N. Y.
Commodore Heaters Corp, 11 West 42nd St, New York, N. Y.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St Louis, Mo.
Modine Mfg Co, Racine, Wis.
Rome Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Tuttle & Bailey, Inc, New Britain, Conn.

CONVERTERS, ROTARY, ELECTRIC

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Bogue Electric Co, 80 Glover Ave, Paterson, N. J.
Century Electric Co, 1806 Pine St, St Louis, Mo.
Diehl Mfg Co, Elizabethport, N. J.
Erie Electric Co, 124 Church St, Buffalo, N. Y.
Adv page 244
Forbes & Myers, 174 Union St, Worcester, Mass.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Janette Mfg Co, 556 W Monroe St, Chicago, Ill.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

CONVEYING SYSTEMS, HYDRAULIC

Allen-Sherman-Hoff Co, 227 S 15 St, Philadelphia, Pa.
National Conveyors Co, Inc, 50 Church St, New York, N. Y.
United Conveyor Corp, Dearborn & Van Buren Sts, Chicago, Ill.

CONVEYING SYSTEMS, PNEUMATIC OR STEAM-JET

Allen Billmyre Corp, Daily News Bldg, New York, N. Y.
Allen-Sherman-Hoff Co, 227 S 15 St, Philadelphia, Pa.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Dracco Corp, 4083 E 116 St, Cleveland, Ohio
Fuller Co, 111 Bridge St, Catasaqua, Pa.
Hahn Engineering Div, 233 Broadway, New York, N. Y.
Adv page 194
Holly Pneumatic Systems, Inc, Dept 15, 15 E 40th St, New York, N. Y.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
National Conveyors Co, 50 Church St, New York, N. Y.
Skinner Heating & Ventilating Co, 1990 N 9th, St. Louis, Mo.
Sterling Blower Co, 791 Windsor St, Hartford, Conn.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
United Conveyor Corp, Dearborn & Van Buren Sts, Chicago, Ill.
U S Hoffman Machinery Corp, 105 4th Ave, New York, N. Y.

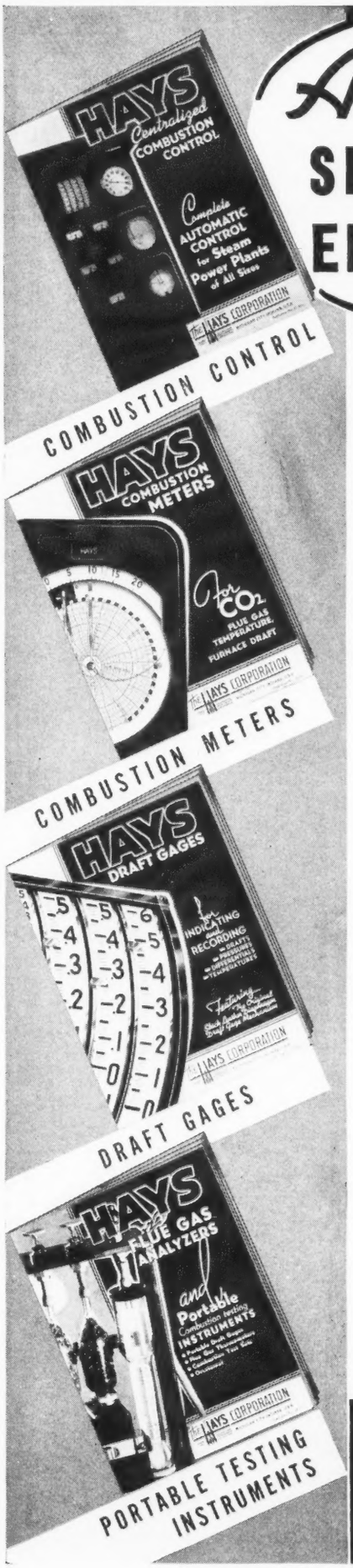
CONVEYORS, BELT

Alvey Ferguson Co, Cincinnati, Ohio
Barber-Greene Co, Aurora, Ill.
Bartlett & Snow, C O, Co, Cleveland, Ohio.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Columbus Conveyor Co, Columbus, Ohio.

ASH and FLY-ASH CONVEYING SYSTEMS

CAST-IRON SECTIONAL STORAGE UNITS
• REFRACTORY-LINED CAST-IRON HOPPERS •
MECHANICAL SOOT BLOWERS for FIRE-TUBE BOILERS

HAHN ENGINEERING DIVISION
LURIA STEEL & TRADING CORP.
233 BROADWAY NEW YORK, N. Y.



A Complete SERVICE IN COMBUSTION EFFICIENCY AND ECONOMY

COMBUSTION CONTROL

Hays offers complete automatic combustion control in a variety of types to fit the mechanical and economic needs of any sized steam plant burning any kind of fuel: *Metering Control* in which all variables are accurately measured and corrected simultaneously to keep steam pressure constant regardless of wide variations in steam demand. *Positioning Control* in which steam is maintained at a predetermined required pressure by adjusting damper position and rate of fuel feed direct from Master Controller by means of rigid connections. *Furnace Draft Control* through automatic electrical regulation of uptake dampers.

COMBUSTION METERS

Hays Combustion Recorders for CO_2 operate on the Orsat principle, employing a small stream of water for complete operation—chilling hot flue gases, precipitating sulphurous mists, aspirating flue gas to analyzer and completely analyzing sample. Only Hays CO_2 Recorders compensate for all variables of pressure, temperature and liquid level. Offered in several styles for integral or remote panel mounting.

DRAFT GAGES

Hays slack leather diaphragm or Dry Type (no liquid) Pointer Gages have revolutionized draft gage design. Offered for Draft, Pressure and Differential measurement in wall, flush panel, and portable cases in ranges between .1 inch water to 100 in. water. Temperature and pressure units can also be incorporated. A complete line of liquid inclined tube gages for ranges between ½ in. and 4 in. water in portable and wall mounted styles is also offered. Also U-Tube (manometer), direct reading, single and multiple tube, and Vernier Scale Gages.

PORTABLE COMBUSTION TESTING INSTRUMENTS

Hays Orsat analyzers are offered in one, two and three chamber models for CO_2, CO or O_2 determinations, either 50 cc or 100 cc capacity. Rugged construction with a minimum of glass parts, metal needle valves, metal wool-filled absorption pipettes, compact, light weight, high visibility, speedy operation, accurate results. Combined with draft gages and thermometers for complete combustion tests. An automatic model is offered in the Hays ORSATOMAT. Separate portable draft gages are offered in both dry and liquid types.

Hays engineering service is nation wide. Sales and service branches in charge of District Representatives are maintained in the principal cities of the U. S. A. and Canada. Consult your telephone directory for address of the Hays representative in your city.

Keep your files on boiler room instruments and control up-to-date. Check the catalogs in which you are interested. Pin this coupon to your letterhead and mail to The Hays Corporation.

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- ☐ Combustion Control
- ☐ Combustion Meters
- ☐ Draft Gages
- ☐ Portable Testing Instruments

Name _____

Company _____

Address _____

The HAYS CORPORATION

SINCE 1901 — COMBUSTION INSTRUMENTS AND CONTROL — MICHIGAN CITY, INDIANA, U.S.A

Continental Gin Co, 4500 Fifth Ave, South, Birmingham, Ala.
Diamond Iron Works Inc, Minneapolis, Minn.
Elgin Mfg Co, Elgin, Ill.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio.
Farquhar, A B, Co, York, Pa.
General Conveyor Co, 38-40 22nd St, Long Island City, N. Y.
General Machinery Co, Riverside Ave, Spokane, Wash.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Godfrey Conveyor Corp, Dept A-77, Elkhart, Ind.
Great Western Mfg Co, Leavenworth, Kansas.
Haslett Chute & Conveyor Co, Oaks, Pa.
Jeffrey Mfg Co, 932-99 N Fourth St, Columbus, Ohio.
Johns Conveyor Div, Osborne Mfg Co, 5401 Hamilton Ave, Cleveland, Ohio.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Link-Belt Co, 220 S Belmont Ave, Indianapolis, Ind.
Adv page 3
Logan Co, Louisville, Ky.
Murray, D J, Mfg Co, Wausau, Wis.
Norfolk Iron Co, North Quincy, Mass.
Palmer-Bee Co, Detroit, Mich.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Robinson Mfg Co, Muncy, Pa.
Sprout, Waldon & Co, Muncy, Pa.
Standard Conveyor Co, N St. Paul, Minn.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Webster Mfg Inc, Tiffin, Ohio
Wickwire Spencer Steel Co, 500 Fifth Ave, New York, N. Y.

CONVEYORS, FEEDER

Ajax Flexible Coupling Co, 11 English St, Westfield, N. Y.
Adv page 150
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Bartlett & Snow, C O, Co, Cleveland, Ohio
Brady Conveyors Corp, 20 W Jackson Ave, Chicago, Ill.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Diamond Iron Works Inc, Minneapolis, Minn.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio.
Farquhar, A B, Co, York, Pa.
General Machinery Co, Riverside Ave, Spokane, Wash.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Jeffrey Mfg Co, 932–99 N 4th St, Columbus, Ohio
Johns Conveyor Div, 5401 Hamilton Ave, Cleveland, Ohio.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Palmer-Bee Co, Detroit, Mich.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Savage, W J, Co, Knoxville, Tenn.
Standard Transmission Equipment Co, 416 W 8th St, Los Angeles, Calif.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Syntron Co, Homer City, Pa.

CONVEYORS, PORTABLE

Alvey-Ferguson Co, Cincinnati, Ohio
Barber-Greene Co, Aurora, Ill.
Diamond Iron Works Inc, Minneapolis, Minn.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio.
Farquhar, A B, Co, York, Pa.
General Machinery Co, Riverside Ave, Spokane, Wash.
Godfrey Conveyor Co, Dept A 77, Elkhart, Ind.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Link-Belt Co, 2045 W Hunting Park Ave, Philadelphia, Pa.
Adv page 3
Logan Co, Louisville, Ky.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Standard Conveyor Co, N St. Paul, Minn.
Standard Transmission Equipment Co, 416 W 8th St, Los Angeles, Calif.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47

CONVEYORS, SCRAPER, BUCKET, SCREW, FLIGHT, DRAG

Alvey-Ferguson Co, Cincinnati, Ohio
Alpha Tank & Sheet Metal Mfg Co, 5005 S 38th St, St. Louis, Mo.
Bartlett & Snow, C O, Co, Cleveland, Ohio.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Columbus Conveyor Co, Columbus, Ohio.
Continental Gin Co, 4500 Fifth Ave S, Birmingham, Ala.
Diamond Iron Works Inc, Minneapolis, Minn.
Diamond Mfg Co, Wyoming, Pa.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio.
Farquhar, A B, Co, York, Pa.
General Machinery Co, Spokane, Wash.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Godfrey Conveyor Co, Dept A 77, Elkhart, Ind.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Logan Co, Louisville, Ky.
Murray, D J, Mfg Co, Wausau, Wis.
Palmer-Bee Co, Detroit, Mich.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Sauerman Bros Inc, 462 S Clinton St, Chicago, Ill.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Webster Mfg Inc, Tiffin, Ohio.

COOLERS, BRINE

(See Also Heat Exchangers)
Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Andale Co, 1600 Arch St, Philadelphia, Pa.
Baker Ice Machine Co, Inc, Omaha, Neb.
California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Griscom-Russell Co, 385 Madison Ave, New York, N. Y.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Richmond Engrg Co, Inc, Seventh & Hospital Sts, Richmond, Va.
Stearns-Roger Mfg Co, Denver, Colo.
Struthers-Wells Titusville Corp, Warren, Pa.
Vesterdahl, Karl, & Co, 90 West St, New York, N. Y.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machinery Corp, York, Pa.

COOLERS, OIL

Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Alco Products Div, 36 Church St, New York, N. Y.
Adv page 172
Andale Co, 1600 Arch St, Philadelphia, Pa.
Bell & Gossett Co, Chicago, Ill.
Burt Mfg Co, 232 Main St, Akron, Ohio
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Harrison Radiator Co, Lockport, N. Y.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Marlo Coil Co, St Louis, Mo.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Staples & Pfeiffer Ltd, 528 Bryant St, San Francisco, Calif.
Struthers-Wells Titusville Corp, Warren, Pa.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.
Worthington Pump & Machinery Corp., Harrison, N. J.
York Ice Machinery Corp, York, Pa.
Young Radiator Co, Racine, Wis.
Zallea Bros & Johnson, 820 Locust Ave, Wilmington, Del.

COOLERS, UNIT, ROOM

Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Hastings Air Conditioning Co, Hastings, Nebr.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Ice Cooling Appliance Corp, Morrison, Ill.
Ilg Electric Ventilating Co, Chicago, Ill.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St Louis, Mo.
Modine Mfg Co, Racine, Wis.
Murray, D J, Mfg Co, Wausau, Wis.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Palmers Mfg Co, Phoenix, Ariz.
Peerless of America, Inc, Marion, Ind.
Rempe Co, 340 N Sacramento Blvd, Chicago, Ill.
Skinner Heating & Ventilating Co, 1990 N 9th, St. Louis, Mo.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machy Corp, York, Pa.
Young Radiator Co, Racine, Wis.

COOLING SYSTEMS, SPRAY

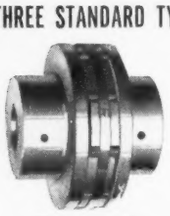
Binks Mfg Co, 3114-40 Carroll Ave, Chicago, Ill.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Carrier Corp, Syracuse, N. Y.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio.
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kans.
Adv page 119
Marlo Coil Co, St. Louis, Mo.

It Pays To Use
L-R FLEXIBLE COUPLINGS

Your dollars go further, you get higher power transmission efficiency when you use L-R Flexible Couplings. It has paid others to use them and it will pay you too! L-R engineers can help you on flexible coupling requirements—and if standard couplings (in stock for prompt shipment) do not meet your needs—they will work out new designs that will.

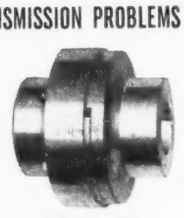
POWER TRANSMISSION DATA AND CATALOG
Engineers interested in new ideas about power transmission as related to flexible couplings should write for this catalog.

THREE STANDARD TYPES FOR ALL POWER TRANSMISSION PROBLEMS



Type W
General Service
1½" to 16¾" Bores
2 to 2500 h. p. at 100 r.p.m.

Type IA
For Small Pumps, Machines and Light Applications
3/16" to 2¼" Bores
1/6 to 50 h.p. at 1750 r.p.m.



Type H
Heavy Duty
1½" to 9½" Bores
2½ to 806 h. p. at 100 r.p.m.

LOVEJOY FLEXIBLE COUPLING CO. 4976 WEST LAKE ST. CHICAGO, ILLINOIS

Palmers Mfg Co, Phoenix, Ariz.
Schubert-Christy Corp, 1600 Georgia St, St. Louis, Mo.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Spray Engrg Co, 111 Central St, Somerville, Mass.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.
Adv pages 103, 217, 222, 252, 254d
York Ice Machy Corp, York, Pa.

CORK PRODUCTS

Armstrong Cork Co, Industrial Div, Lancaster, Pa.
Adv page 197
Butterworth, B T, Jr, New Canaan, Conn.
Cork Import Corp, 330 West 42nd St, New York, N. Y.
Cork Insulation Co, 155 E 44th St, New York, N. Y.
Mundet Cork Corp, 65 S 11th St, Brooklyn, N. Y.
United Cork Cos, Kearny, N. J.
York Ice Machy Corp, York, Pa.

COUNTERS, REVOLUTION

Bristol Co, Waterbury, Conn.
Durant Mfg Co, 1954 N Buffum St, Milwaukee, Wis.
Lonergan, J E, Co, 211 Race St, Philadelphia, Pa.
Adv pages 209, 254b
Photoswitch Inc, 21 Chestnut St, Cambridge, Mass.
Veeder-Root Inc, Hartford, Conn.

COUPLINGS, PIPE

Central Forging Co, Catawissa, Pa.
Chase Brass & Copper Co, 236 Grand St, Waterbury, Conn.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Dresser Mfg Co, Bradford, Pa.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Harrisburg Steel Corp, Harrisburg, Pa.
Jarecki Mfg Co, Erie, Pa.
Kennedy Valve Mfg Co, Elmira, N. Y.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Limbert, Geo B, & Co, 570 Fulton St, Chicago, Ill.
Malleable Iron Fittings Co, Branford, Conn.
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio.
Pittsburgh Valve & Fittings Corp, Barberton, Ohio.
Sherman, H B, Mfg Co, Battle Creek, Mich.
Walworth Co, Inc, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159
Youngstown Sheet & Tube Co., Youngstown, Ohio
Adv page 176

COUPLINGS, SHAFT, FLEXIBLE

Ajax Flexible Coupling Co, 11 English St, Westfield, N. Y.
Adv page 150
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Flexible Coupling Co, Erie, Pa.
Atlantic Gear Wks, Inc, 198 Lafayette St, New York, N. Y. N. Y.
Bartlett Hayward Div, Koppers Co, Scott St, Baltimore, Md.
Adv page 143
Bond, Chas, Co, 617-623 Arch St, Philadelphia, Pa.
Boston Gear Works, Inc, North Quincy, Mass.
Brown Engineering Co, 119 E 3rd St, Reading, Pa.
Bruce-Macbeth Engine Co, 2111 Center St, N W, Cleveland, Ohio.
Chicago Pulley & Shafting Co, Chicago, Ill.
Continental Gin Co, 4500 Fifth Ave S, Birmingham, Ala.
Crocker-Wheeler Elec Mfg Co, Ampere, N. J.
Adv pages 22, 23
Cullman Wheel Co, 1344 Altgeld St, Chicago, Ill.

Look for the noun in the product listing, for example:

"Condensers, Surface"
not
"Surface Condensers"

De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Diamond Chain & Mfg Co, 444 Kentucky Ave, Indianapolis, Ind.
Dodge Mfg Co, Mishawaka, Ind.
F A B Mfg Co, Inc, 1249 67th St, Oakland, Calif.
Falk Corp, 3104 W Canal St, Milwaukee, Wis.
Falls Clutch & Machinery Co, Cuyahoga Falls, Ohio.
Farrel-Birmingham Co, Inc, 344 Vulcan St, Buffalo, N. Y.
Foote Bros Gear & Machine Co, Western Blvd, Chicago, Ill.
Gears & Forgings, Inc, Cleveland, Ohio.
Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio.
James, D O, Mfg Co, W Monroe, Chicago, Ill.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Jones, W A, Foundry & Machine Co, Chicago, Ill.
Link-Belt Co, 220 S Belmont Ave, Indianapolis, Ind.
Adv page 3
Lovejoy Flexible Coupling Co, West Lake St, Chicago, Ill.
Adv pages 196, 274
Mall Tool Co, 7740 S Chicago Ave, Chicago, Ill.
Medart Co, 3548 DeKalb St, St. Louis, Mo.
Meriam Co, Cleveland, Ohio
Mesta Machine Co, P O Box 1466, Pittsburgh, Pa.
Morse Chain Co, Ithaca, N. Y.
Adv page 170
Nicholson, W H, & Co, 125 Oregon St, Wilkes-Barre, Pa.
Adv pages 206, 246, 248
Palmer-Bee Co, Detroit, Mich.
Philadelphia Gear Works, Erie Ave & G St, Philadelphia, Pa.
Adv page 175
Poole Foundry & Machine Co, Baltimore, Md.
Ramsey Chain Co, Inc, 1010 Broadway, Albany, N. Y.
Royersford Foundry & Machine Co, 75 Main St, Royersford, Pa.
Smith & Serrell, 20 Washington Place, Newark, N. J.
Smith, Winfield H, 330 West St, Springville, N. Y.
Spicer Mfg Corp, Toledo, Ohio.
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Thomas Flexible Coupling Co, Warren, Pa.
Union Chain & Mfg Co, Sandusky, Ohio.
Universal Gear Corp, 1452 E 19th St, Indianapolis, Ind.
Waldron, John, Corp, Box 110, New Brunswick, N. J.
Webster Manufacturing Inc, Tiffin, Ohio
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

COUPLINGS, VARIABLE-SPEED

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Electric Machinery Mfg Co, 1331 Tyler St, N E, Minneapolis, Minn.
Twin Disc Clutch Co, Racine, Wis.

CRANES, ELECTRIC TRAVELING

American Hoist & Derrick Co, St Paul, Minn.
Chisholm-Moore Hoist Corp, 6015 Fremont, Tonawanda, N. Y.
Cleveland Crane & Engrg Co, Wickliffe, Ohio.
Conco Engrg Wks, Mendota, Ill.
Detroit Hoist & Machine Co, Detroit, Mich.
Euclid Crane & Hoist Co, Euclid, Ohio.
Harnischfeger Corp, Milwaukee, Wis.
Lakeside Bridge & Steel Co, Milwaukee, Wis.
Lane Mfg Co, Montpelier, Vt.
Link-Belt Speeder Corp, 301 W Pershing Rd, Chicago, Ill.
Northern Engrg Works, Detroit, Mich.
Shaw-Box Crane & Hoist Div, Muskegon, Mich.
Shepard Niles Crane & Hoist Corp, 453 Schuyler Ave, Montour Falls, N. Y.
Union Mfg Co, New Britain, Conn.
Whiting Corp, 15657 Lathrop Ave, Harvey, Ill.
Wright Mfg Div of American Chain & Cable Co, York, Pa.

CRANES, HAND-POWER

Bradney Machine Co, Inc, Middletown, N. Y.
Bridgeport Chain & Mfg Co, Bridgeport, Conn.
Chisholm-Moore Hoist Corp, 6015 Fremont, Tonawanda, N. Y.
Cleveland Crane & Engrg Co, Wickliffe, Ohio.
Conco Engrg Wks, Mendota, Ill.
Detroit Hoist & Machine Co, Detroit, Mich.
Diamond Iron Works Inc, Minneapolis, Minn.
Euclid Crane & Hoist Co, Euclid, Ohio
Harrington Co, 17th & Callowhill Sts, Philadelphia, Pa.

"HALLOWELL"

STEEL SHAFT COLLARS

Fig. 1432

Beautifully machined, unbreakable and fitted with "Unbrako" Self-Locking Set Screw, "Hallowell" Collars are low priced and enjoy a wide popularity. They're worth your investigation now!

Write for Details

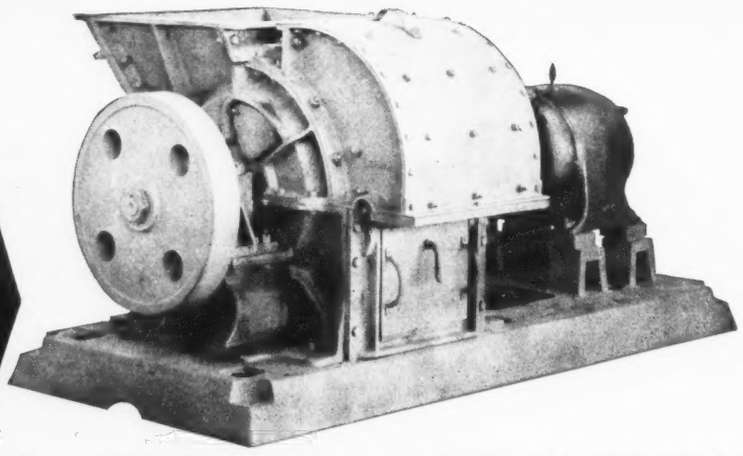
STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 577
BRANCHES
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

YOU can eliminate waste of refrigeration from cold lines by insulating with Armstrong's Cork Covering. This dependable and lasting insulation is accurately sized to fit all standard pipe and fittings. It is rigid and will not sag so provides the same effective protection for fittings as for other parts of the line. Thicknesses to meet any requirement.

Write for detailed information. Armstrong Cork Company, 978 Concord St., Lancaster, Pennsylvania.

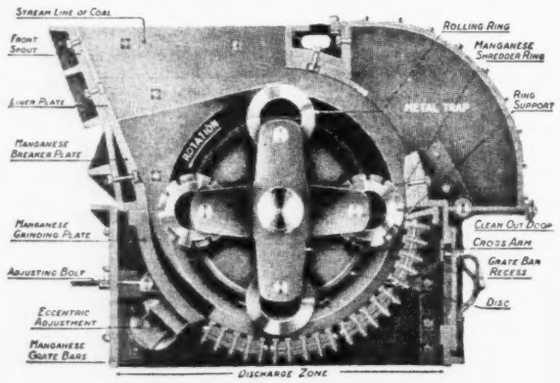
ARMSTRONG'S CORK COVERING
FOR COLD LINES
CORKBOARD FOR COLD ROOMS

AMERICAN RING CRUSHERS



SIZE COAL FOR EFFICIENT COMBUSTION

Run-of-mine or lump coal reduced to proper size in one operation—at low cost



Cross-sectional view of American Ring Crusher

In American Crushers, Manganese Steel Rings apply centrifugal force to strike, roll and grind the coal during the crushing operation.

One of the Manganese Steel Shredder Rings, used in the "American" Crusher which splits the coal and prevents clogging. This is an exclusive "American" feature which eliminates the chance of crushing the coal and is largely responsible for the low cost crushing and exact sizing with the "AMERICAN."

American Rolling Ring Crushers differ from other centrifugal crushers in that their housings are heavy steel castings, reinforced with ribs making them unbreakable from any crushing strain.

In operation, centrifugal force is applied at right angles to a horizontal shaft. Material to be crushed enters from the top, falls on the rotor and is struck by rings in suspension which shatter and distribute the coal before it reaches the breaker and grinding plate. By a simple adjustment of the patented grinding plate (made of manganese to insure long wear and sturdiness) coal can be sized to any requirements whether for stoker or pulverized fuel firing.

The average cost of coal crushing with the American is less than 1¢ per ton for all charges including maintenance, power, labor, depreciation and interest on the investment.

SPEED, CAPACITY, HORSEPOWER

	SPEED	APPROX.	APPROXIMATE CAPACITIES					SIZE	
No.	RPM	H. P.	1½"	1¼"	1"	¾"	½"	LUMP	R.O.M.
15S	600-720	20-25	80	50-65	45-50	35-40	25-30	10"	
18S	600-720	25-30	90	70-80	60-65	50-55	40-45	12"	
24S	600-720	30-40	150	130-140	100-120	80-100	60-70	18"	
30S	600-720	50-60	225	175-200	150-170	130-150	80-100	20"	
38S	600-720	60-75	300	225-250	200-235	175-200	125-150	24"	
42S	600-720	75-100	350	300-325	285-325	275-300	175-200	28"	
48S	600-720	100-125	400	350-375	330-350	300-325	225-250	28"	
54S	600-720	125-150	450	390-420	360-380	325-340	250-275	28"	
60S	600-720	150-175	500	425-450	400-425	350-375	275-300	28"	

ASK FOR "AMERICAN" ASSISTANCE

Many leading power plants, by availing themselves of "American" engineering service and recommendations have improved combustion and reduced coal preparation costs. Call on us to analysis your problem and help you solve it.

AMERICAN PULVERIZER COMPANY
1219 Macklind Avenue
St. Louis, Missouri
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS

Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio.
Industrial Brownhoist Corp, Bay City, Mich.
Louden Machinery Co, Fairfield, Iowa.
Mahr Mfg. Co, Milwaukee, Wis.
Northern Engrg Works, Detroit.
Palmer-Bee Co, Detroit, Mich.
Shaw-Box Crane & Hoist Div, Muskegon, Mich.
Shepard Niles Crane & Hoist Corp, 453 Schuyler Ave, Montour Falls, N. Y.
Union Mfg Co, New Britain, Conn.
Whiting Corp, 15657 Lathrop Ave, Harvey, Ill.
Wright Mfg Div of American Chain & Cable Co, York, Pa.

CRUSHERS, COAL

American Pulverizer Co, 1029 Macklind Ave, St. Louis, Mo.
Adv page 198
Bartlett & Snow, C O, Co, Cleveland, Ohio
Diamond Iron Works, Minneapolis, Minn.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.
Adv page 3
Koppers Co, Pittsburgh, Pa.
Mahr Mfg Co, Minneapolis, Minn.
Marion Machine Foundry & Supply Co, Marion, Ind.
Penn Crusher Co, Phila, Pa.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Stearns-Roger Mfg Co, Denver, Colo.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Sturtevant Mill Co, Harrison Sq, Dorchester, Boston, Mass.
Adv page 236
Vulcan Iron Works, 750 S Main St, Wilkes-Barre, Pa.
Webster Mfg Inc, Tiffin, Ohio.

CUPS, GREASE

Alemite Div, Stewart-Warner Corp, Chicago, Ill.
American Injector Co, Detroit, Mich.
Bowen Products Corp, Auburn, N. Y.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Detroit Lubricator Co, 5900 Trumbull Ave, Detroit, Mich.
Hunter Pressed Steel Co, 8000 Maple Ave, Lansdale, Pa.
Jarecki Mfg Co, Erie, Pa.
Keystone Lubricating Co, 21st Clearfield & Lippincott Sts, Phila, Pa.
Link-Belt Co, 519 N Holmes Ave, Indianapolis, Ind.
Adv page 3
Lonergan, J E, Co, 211 Race St, Philadelphia, Pa.
Adv pages 209, 254b
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, Ohio.
Adv pages 30, 31
Nathan Mfg Co, 250 Park Ave, New York, N. Y.
Powell, Wm, Co, Cincinnati, O.
Adv pages 152, 153
Stewart-Warner Corp, 1826 W Diversey Pkwy, Chicago, Ill.
Williams, D T, Valve Co, Spring Grove Ave, Cincinnati, O.

CUTTING & THREADING TOOLS, PIPE

Beaver Pipe Tools, Inc, 310 Power Ave, Warren, Ohio
Bignall & Keeler Mach Works, 512 Leclaire Ave, Edwardsville, Ill.
Cox & Sons Co, South Bridgeton, N. J.
Curtis & Curtis Co, 302 Garden St, Bridgeport, Conn.
Jarecki Mfg Co, Erie, Pa.
Landis Machine Co, Waynesboro, Pa.
Oster Mfg Co, Cleveland, Ohio
Ridge Tool Co, Elyria, Ohio
Toledo Pipe Threading Machine Co, 1441 Summit St, Toledo, Ohio

CUTTING TOOLS, BOILER-TUBE

Cox & Sons Co, South Bridgeton, N. J.
Faessler, J, Mfg Co, Moberly, Mo.
Landis Machine Co, Waynesboro, Pa.
Wiedeke, Gustav, Co, 1833 Richard St, Dayton, Ohio.

DAMPERS, DUCT, BREECHING

American Warming & Ventilating Co, Toledo, Ohio.
Anemostat Corp of America, 10 East 39th St, New York, N. Y.
Barber Colman Co, Rockford, Ill.
Connery Construction Co, 2nd & Luzerne Sts, Phila, Pa.
Adv page 184
Heacon Inc, Luzerne & 2nd Sts, Philadelphia, Pa.
Adv page 200
Mecklenburg Iron Works, P O Box 599, 617 N Summit St, Charlotte, N. C.
Stearns-Roger Mfg Co, Denver, Colo.
Treadwell, M H, Co, 140 Cedar St, New York, N. Y.

DAMPERS, VIBRATION, SPRING & RUBBER

Butterworth, B T, Jr, New Canaan, Conn.
Korfund Co, 48-23 32nd Pl, Long Island City, N. Y.
Vibration Eliminator Co, 8-22 Astoria Blvd, Astoria, L. I.

DEAERATORS

(See Heaters)

DEALERS, EQUIPMENT

(See Searchlight Section of this issue, page 281, and Classified Directory, page 268 of December POWER)

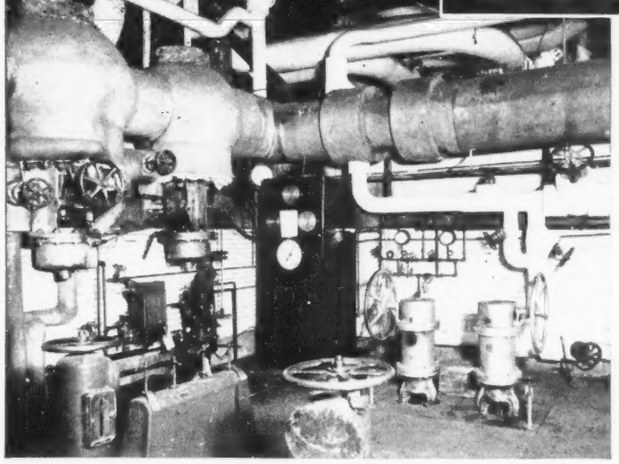
DEHUMIDIFIERS

Air & Refrigeration Corp, New York, N. Y.
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Aqua Sorb Co, East Orange, N. J.
Bryant Heater Co, 17825 St Clair Ave, Cleveland, Ohio
Carrier Corp, Syracuse, N. Y.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Kaufman, H J, 13215 Roselawn Ave, Detroit, Mich.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Pittsburgh Lectrodryer Corp, Pittsburgh, Pa.
Refrigeration Economies Co, Canton, Ohio
Ross, J O, Engrg Corp, New York, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
York Ice Machy Corp, York, Pa.

DESUPERHEATERS

Andale Co, 1600 Arch St, Philadelphia, Pa.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
General Regulator Corp, 165 Broadway, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 148
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Mercon Regulator Co, 2357 N 29th St, Milwaukee, Wis.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.

DESUPERHEATERS



For Your Special Requirements

Whatever your plant conditions, you can obtain the necessary operating flexibility and accurate regulation of steam temperature with the rugged, simply-controlled Republic-Smoot desuperheaters described below.

RATIO TYPE

This desuperheater is a self-supported venturi in which the desuperheating water, completely evaporated at all flows, is controlled by the steam flow in the correct proportion to reduce the steam temperature to the required value.

RATIO TANK TYPE

This unit is similar to the ratio type except that a water tank is added to give emergency water reserve.

STEAM ATOMIZING TYPE

In this desuperheater, built for extremely wide range operation and zero pressure loss, the desuperheating water is completely atomized at all rates of flow by a small quantity of high-pressure steam.

MECHANICAL TYPE

This unit is designed for special applications such as the control of turbine exhaust temperature or for use where atomizing steam is not available.

A Republic-Smoot engineer will gladly consult with you on your specific desuperheating problem. Write today, without obligation, for further details.

TYPICAL INSTALLATIONS

APPALACHIAN ELECTRIC POWER CO.
BOSTON EDISON CO.
BROOKLYN EDISON CO.
CINCINNATI GAS AND ELECTRIC CO.
E. I. DU PONT DE NEMOURS & CO.
NORTHERN PAPER MILLS
POTOMAC EDISON CO.
JACOB RUPPERT BREWERY
STANDARD OIL CO. OF N. J.
UNION BAG & PAPER CO.
THE TEXAS CO.
UNITED ILLUMINATING CO.

REPUBLIC FLOW METERS CO. 2222 DIVERSEY PKWY. CHICAGO, ILLINOIS

Spence Engrg Co, Inc, 61 Grant St, Walden, N. Y.
Swartwout Co, 1851 Euclid Ave, Cleveland, Ohio
Adv page 310

DETECTORS, REFRIGERANT-GAS

Frigidaire Commercial & Air Cond Div, Dayton, Ohio
Imperial Brass Mfg Co, 564 S Racine Ave, Chicago, Ill.
Linde Air Products Co, 30 E 42nd St, New York, N. Y.
Adv page 21
Turner Brass Wks, Sycamore, Ill.

DIAPHRAGM VALVES

(See Valves, Diaphragm)

DIFFUSERS, AIR, HIGH VELOCITY

Air Devices, Inc, 17 East 42nd St, New York, N. Y.
Air & Refrigeration Corp, New York, N. Y.
Anemostat Corp of America, 10 E 39th St, New York, N. Y.
Barber Colman Co, Rockford, Ill.
Dorex Div, W B Conner Engrg Corp, 114 E 32nd St, New York, N. Y.
Knowles Mushroom Ventilator Co, Montclair, N. J.
Tuttle & Bailey, Inc, New Britain, Conn.
Waterloo Register Co, Waterloo, Iowa

DC GENERATORS

(See Generators, Electric)

DC MOTORS

(See Motors, Electric)

DIESEL ENGINES

(See Engines, Oil)

DRESSERS, COMMUTATOR

Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Grobet File Corp of America, 3 Park Place, New York, N. Y.
Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.
Martindale Electric Co, 1385 Hird Ave, Cleveland, Ohio

DRESSING, BELT

Acheson Colloids Corp, 3000 Washington Ave, Port Huron, Mich.
Alexander Bros, 410 N 3rd St, Philadelphia, Pa.
Baldwin Belting & Leather Co, 85 Chambers St, New York, N. Y.
Cling-Surface Co, Buffalo, N. Y.
Dixon, Joseph, Crucible Co, 170 Wayne St, Jersey City, N. J.
Adv page 272
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Graton & Knight Co, Worcester, Mass.
Houghton, E F, & Co, 244-50 W Somerset St, Phila, Pa.
Page Belting Co, Concord, N. H.
Pennwell Oil & Belting Co, 5 White St, New York, N. Y.
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Philadelphia Belting Co, 6th & Spring Garden Sts, Phila, Pa.
Raniville, F, Co, Grand Rapids, Mich.
Rhoads, J E, & Sons, 35 N Sixth St, Philadelphia, Pa.
Rockwood Mfg Co, 1801 English Ave, Indianapolis, Ind.
Schieren, Chas A, Co, 30-39 Ferry St, New York, N. Y.
Schwartz Belting Co, 74 Murray St, New York, N. Y.
Standard Oil Co, Ind, 910 S Michigan Ave, Chicago, Ill.
Williams, I B & Son, 73 Murray St, New York, N. Y.

DRIERS, COAL

Allis-Chalmers Mfg. Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Process Co, Sea Girt, N. J.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bartlett, C O, & Snow Co, Cleveland, Ohio
Bos-Hatten, Inc, Buffalo, N. Y.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Koppers Co, Pittsburgh Pa.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3

DRILLS, PNEUMATIC, ELECTRIC, PORTABLE

Black & Decker Mfg Co, Towson, Md.
Buckeye Portable Tool Co, Dayton, Ohio
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Clark Electric Co, Louisville, Ky.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Independent Pneumatic Tool Co, 600 W Jackson Blvd, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Keeler, Wm H, Inc, Grand Haven, Mich.
Mall Tool Co, 7740 S Chicago Ave, Chicago, Ill.
Millers Falls Co, 59 Wells St, Greenfield, Mass.
Ryerson, Jos T, & Sons, Inc, 16 & Rockwell Sts, Chicago, Ill.
Skilsaw Inc, 5033 Elston Ave, Chicago, Ill.
Snap-On Tools Corp, Kenosha, Wis.
Standard Electrical Tool Co, 1918 W 8th, Cincinnati, Ohio
Stearns-Roger Mfg Co, Denver, Colo.
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Syntron Co, 492 Lexington Ave, Homer City, Pa.

DUST COLLECTORS

(See Collectors, Dust)

ECONOMIZERS

American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bros, Wm, Boiler & Mfg Co, Nicollet Island Minneapolis, Minn.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Edge Moor Iron Works, 30 Rockefeller Plaza, New York
Adv page 263
Erie City Iron Works, 1422 East Ave, Erie, Pa.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Green Fuel Economizer Co, 627 Main St, Beacon, N. Y.
Adv pages 24, 25
Heilman Boiler Works, Allentown, Pa.
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Springfield Boiler Co, Springfield, Ill.
Stover Steel Tank & Mfg Co, Freeport, Ill.
Sturtevant, B F, Co, 47 Readville St, Mass.
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

EJECTORS

American Injector Co, Detroit, Mich.
Condenser Service & Engineering Co, 310 12th St, Hoboken, N. J.
Corning Glass Works, Dept IP, Corning, N. Y.
Croll-Reynolds Engrg Corp, 17 John St, New York, N. Y.
Adv page 200
Duriron Co, Inc, Dayton, Ohio
Economy Pumps Inc, Hamilton, Ohio
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Hancock Valve Div, Manning, Maxwell & Moore, 143 Elias St, Bridgeport, Conn.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Jarecki Mfg Co, Erie, Pa.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Nathan Mfg Co, 250 Park Ave, New York, N. Y.
Quimby Pump Co, Inc, 347 Thomas St, Newark, N. J.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Sellers, Wm, & Co, 1600 Hamilton St, Philadelphia, Pa.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.

ELECTRICALLY OPERATED VALVES

(See Valves, Motor-Operated)

ELECTRODES, ARC OR GAS WELDING

(See Rods, Welding)

ENGINES, DIESEL

(See Engines, Oil)

ENGINES, GAS

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Atlas Imperial Diesel Engine Co, 1000 19th Ave, Oakland, Cal.
Bruce-Macbeth Engine Co, 2111 Center St, N W, Cleveland, Ohio
Caterpillar Tractor Co, Peoria, Ill.
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Clark Bros Co, Olean, N. Y.
Climax Engrg Co, Clinton, Iowa
Cooper-Bessemer Corp, Mt Vernon, Ohio
Dissinger, C H A, & Bros, Co, Inc, Wrightsville, Pa.
Enterprise Engine & Foundry Co, 2902 19th St, San Francisco, Calif.

HIGH VACUUM EJECTORS

CROLL-REYNOLDS

Croll-Reynolds Evactors represent the highest modern development in steam jet ejectors as indicated by operating installations totalling over three thousand. Croll-Reynolds Chill-Vactors apply this type of vacuum equipment for chilling water and certain solutions. Other Croll-Reynolds products include FlexoDisc Expansion Joints, Heaters, Deaerators, Condensers and Heat Exchangers.

CROLL-REYNOLDS ENGRG. CO.,
17 JOHN ST., NEW YORK, N. Y.

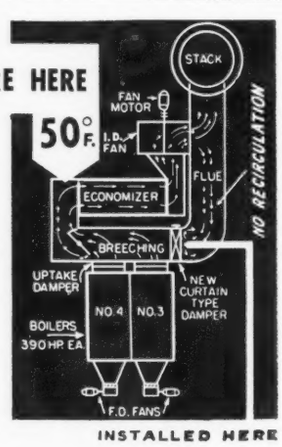
THIS HEACON INC DAMPER RAISED TEMPERATURE HERE 50° F.

INCREASED OUTPUT 100 H.P.

This modern damper provides more reliable operation, more accurate regulation, greater capacity, substantial gains in efficiency, reduced maintenance, increased flexibility, liberal operating clearance without leakage, reduced banking losses, reduced starting time, and safer operation. It is available for horizontal, inclined or vertical flows, unidirectional or reversing, in all sizes and for a wide range of temperatures and gasses. Its modest cost is usually recovered in a few months.

DESCRIPTIVE LITERATURE WILL BE SENT ON REQUEST

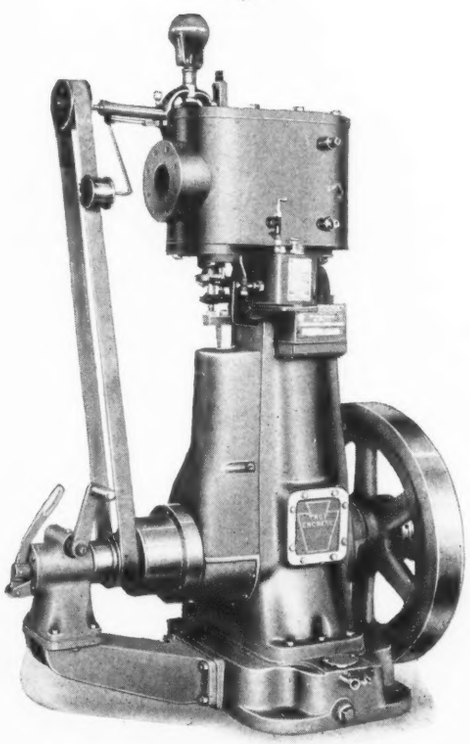
HEACON, INC., Luzerne and Second Streets
PHILADELPHIA, PENNSYLVANIA
ATLANTA • CHICAGO • DENVER • MINNEAPOLIS • SEATTLE • NEW YORK



INSTALLED HERE

TROY-ENGBERG STEAM ENGINE

. . . *definitely* Modern Power for Driving Auxiliary Equipment

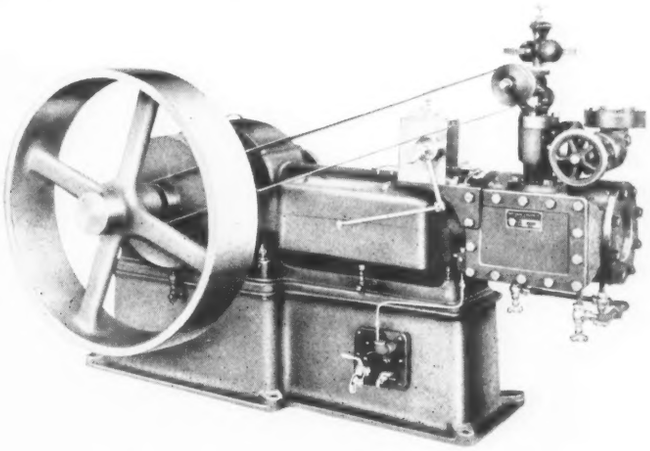


Modern because this steam engine—the counterflow type—will provide for many plants either lower power costs than any other type of drive for stokers, compressors, blowers, fans, pumps, etc., or more advantageous drive characteristics.

In short, the steam engine is one of industry's modern drives!

In many a plant, the cost of power by this steam engine is well under ½ cent per kw.h.; in oil refineries it is used for driving charging pumps largely because of its dependability; in power plants, its flexibility is desired for stoker drives . . . and so it goes.

Today, backed-up orders may keep you from planning any modernizing steps but keep the steam engine in mind when the situation eases up. Later, the power savings possible through the engine may come in handy.



TROY ENGINE AND MACHINE CO.

Established 1870

12-TEM-1

1476 RAILROAD AVE., TROY, PA.

Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
International Harvester Co, 180 N Michigan Ave, Chicago, Ill.
Le Roi Co, Milwaukee, Wis.
National Transit Pump & Machine Co, Oil City, Pa.
Novo Engine Co, 1 Porter St, Lansing, Mich.
Rathbun-Jones Engrg Co, Toledo, Ohio
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Superior Engine Div, National Supply Co, Springfield, Ohio
Adv page 266
Titusville Iron Works Co, Titusville, Pa.
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Adv pages 11, 19, 37, 43
Briggs & Stratton Corp, Milwaukee, Wis.
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Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Hercules Motor Corp, Canton, O.
International Harvester Co, 180 N Michigan Ave, Chicago, Ill.
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Lycoming Mfg Div, Williamsport, Pa.
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ENGINES, OIL

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Adv pages 11, 19, 37, 43
American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Anderson Diesel Engine Co, 6245 State Rd, Tacony, Pa.
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Baldwin De La Vergne Sales Corp, Paschall P O, Philadelphia, Pa.
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Enterprise Engine & Foundry Co, 2902 19th St, San Francisco, Calif.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Fulton Iron Works, 6400 Gambleton Pl, St Louis, Mo.
General Motors Sales Corp, Cleveland, Ohio
Hercules Motors Corp, Canton.
Hill Diesel Engine Co, Lansing, Mich.
Hooven, Owens, Rentschler Div, Genl Mach Corp, Hamilton, O.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
International Harvester Co, 180 N Michigan Ave, Chicago, Ill.
Johnson Mfg Co, Fox & Holly Sts, Seattle, Wash.
Kahlenberg Bros Co, Two Rivers, Wis.
Lister-Blackstone Inc, 1706 S 68th St, Milwaukee, Wis.
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Stover Mfg & Engine Co, Ellis St, Freeport, Ill.
Superior Engine Div, National Supply Co, Springfield, Ohio
Adv page 266
Titusville Iron Works Co, Titusville, Pa.
Union Diesel Engine Co, 2200 E 7th St, Oakland, Calif.
Venn-Severin Machine Co, 1317 W North Ave, Chicago, Ill.
Washington Iron Works, 6th Ave South, Seattle, Wash.
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ENGINES, STEAM

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Ames Iron Works, Oswego, N. Y.
Dake Engine Co, 633 Monroe St, Grand Haven, Mich.
Elliott Co, Ridgeway, Pa.
Adv pages 8, 9
Erie City Iron Works, 1422 East Ave, Erie, Pa.
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Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
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Adv page 172
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
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Adv page 200
Davis Engrg Corp, 1064-16 E Grand Ave, Elizabeth, N. J.
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Adv page 28
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Henszey Co, Dept D-14, Watertown, Wis.
Adv pages 183, 213, 220, 232
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Manistee Iron Works, Manistee, Mich.
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Adv pages 54, 55
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Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
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Adv page 141
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Adv page 279
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Adv page 203
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De Bothezat Ventilating Equip Div, East Moline, Ill.
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Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
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Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
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Adv page 119
South Bend Air Products Inc, 322 E Colfax Ave, South Bend, Ind.
Adv page 255
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Wagner Electric Corp, St Louis, Mo.
Wing L J, Mfg Co, W 14th St & 7th Ave, New York, N. Y.
Adv page 182

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(See Conveyors, Feeder)

FEEDERS, CHEMICAL

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Adv pages 11, 19, 37, 43
American Water Softener Co, Philadelphia, Pa.
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Bartlett, C O, & Snow Co, Cleveland, Ohio
Black, Sivalls & Bryson, Inc, Oklahoma City, Okla.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Dearborn Chemical Co, 310 S Michigan Ave, Chicago, Ill.
Elgin Softener Corp, 130 N Grove St, Elgin, Ill.
Adv page 238
Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
Fuller Co, 111 Bridge St, Catasaqua, Pa.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
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International Filter Co, 325 W 25th Place, Chicago, Ill.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
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Manzel Bros Co, 326 Babcock St, Buffalo, N. Y.
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Savage, W J, Co, Knoxville, Tenn.
Scaife, Wm B, & Sons Co, River & Ann St, Oakmont, Pa.
Stover Steel Tank & Mfg Co, Freeport, Ill.
Syntron Co, Homer City, Pa.
Water Treatment Co of America, 1151 Hodgkiss, Pittsburgh, Pa.
Adv page 136

FEEDERS, COAL

Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bartlett, C O, & Snow Co, Cleveland, Ohio
Combustion Engineering Co, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Fuller Co, 111 Bridge St, Catasaqua, Pa.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
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Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
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Adv page 105
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(See Packing, Fibre)

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General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
National Vulcanized Fibre Co, Wilmington, Del.
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Adv pages 212, 218, 238, 246
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Adv page 238
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Adv pages 8, 9
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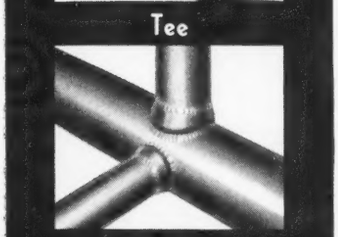

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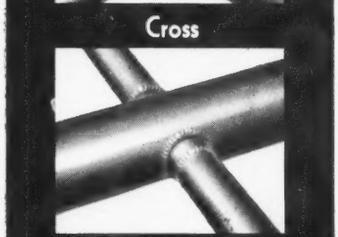

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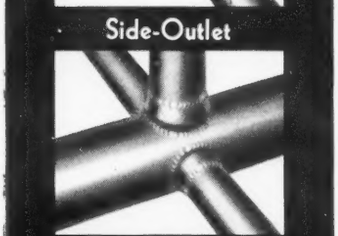

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National Valve & Mfg Co, 3102 Liberty Ave, Pittsburgh, Pa.
Adv page 271
Pittsburgh Piping & Equip Co, 12 43rd St, Pittsburgh, Pa.
Adv page 169
Stockham Pipe Fittings Co, Birmingham, Ala.
Taylor Forge & Pipe Works, P O Box 485, Chicago, Ill.
Adv page 261
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Walworth Co, Inc, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159
Warren Foundry & Pipe Corp, 11 Broadway, New York, N. Y.
Watson-Stil'man Co,Roselle, N. J.
Adv page 207

FITTINGS, PIPE, WELDING

American Rolling Mill Co, 7001 Curtis St, Middletown, Ohio
Bonney Forge & Tool Works, 718 N Meadow, Allentown, Pa.
Adv page 205
Chase Brass & Copper Co, 236 Grand St, Waterbury, Conn.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Grinnell Co, Inc, 277 W Exchange St, Providence, R. I.
Adv page 141
Limbert, Geo B, & Co, 570 Fulton St, Chicago, Ill.
Midwest Piping & Supply Co, 1450 S 2nd St, St. Louis Mo.
Taylor Forge & Pipe Works, P O Box 485, Chicago, Ill.
Adv page 251
Tube Turns, Inc, 251 E Broadway, Louisville, Ky.
Adv page 133
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Walworth Co, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159
Watson-Stillman Co, Roselle, N. J.
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FITTINGS, REFRIGERATION

Baker Ice Machine Co, Inc, Omaha, Neb.
Chase Brass & Copper Co, 236 Grand St, Waterbury Conn.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Conditioning Division, Dayton, Ohio
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Imperial Brass Mfg Co, 514 S Racine Ave, Chicago, Ill.
Vesterdahl, Karl, & Co, 90 West St, New York, N. Y.
Vilter Mfg Co, 2217 S 1st St. Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Walworth Co, 60 E 42nd St, New York, N. Y.
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Watson-Stillman Co, Roselle, N. J.
Adv page 207
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machinery Corp, York, Pa.

FITTINGS, TUBE, COMPRESSION OR SOLDER

American Brass Co, Waterbury, Conn.
Chase Brass & Copper Co, 236 Grand St, Waterbury, Conn.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Dole Valve Co, 1901–1941 Carroll Ave, Chicago, Ill.
Dresser Mfg Co, Bradford, Pa.
Imperial Brass Mfg Co, 514 Racine Ave, Chicago, Ill.
Limbert, Geo B, & Co, 570 Fulton St, Chicago, Ill.
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, Ohio
Adv pages 30, 31
Mueller Brass Co, 1925A Lapeer Ave, Port Huron, Mich.
Nugent, Wm W, & Co, 402 N Hermitage Ave, Chicago, Ill.
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio.
Walworth Co, Inc, 60 E 42nd St., New York, N. Y.
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FLAX PACKING

(See Packing, Flax)

FLEXIBLE COUPLINGS

(See Couplings, Shaft, Flexible)

FLEXIBLE-METAL TUBING

(See Tubing, Metal)

FLOATS

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Harris, Arthur & Co, 212 N Aberdeen St, Chicago, Ill.
Hercules Float Works, 200 Franklin St, Springfield, Mass.
Adv page 150
Kieley & Mueller, Inc, 40 E 13th St, New York, N. Y.
Naugatuck Mfg Co, 460 N Main St, Naugatuck, Conn.
Nicholson, W H, & Co, 125 Oregon St, Wilkes-Barre, Pa.
Adv pages 206, 246, 248
Reliance Gauge Column Co, 5902 Carnegie Ave, Cleveland, Ohio
Stover Steel Tank & Mfg Co, Freeport, Ill.
Wright-Austin Co, Detroit, Mich.

FLOAT VALVES

(See Valves, Float)

FLOORING, IRON & STEEL

(See Plates, Floor)

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(See Collectors, Flyash)

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(See Walls)

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Stearns-Roger Mfg Co, Denver, Colo.

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Colt's Patent Fire Arms Mfg Co, Hartford, Conn.
G & W Electric Specialty Co, 7780 Dante Ave, Chicago, Ill.
General Electric Co, Schenectady, N. Y.
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Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.
Jefferson Electric Co, Bellwood, Ill.
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(See Plugs)

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(See Boards, Gage)

GAGE COCKS

(See Water Columns)

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Adv pages 209, 254b
Manning, Maxwell & Moore, Inc, Bridgeport, Conn.
Marsh, Jas P, Corp, 2049 Southport Ave, Chicago, Ill.
U. S. Gauge Co, 44 Beaver St, New York, N. Y.
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Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
York Ice Machy Corp, York, Pa.

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Bailey Meter Co, 1036 Ivanhoe Road, Cleveland, Ohio.
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Dwyer, F W, Mfg Co, 561 W Washington St, Chicago, Ill.
Ellison Draft Gage Co, 214 W Kinzie St, Chicago, Ill.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, 4 N Central Ave, Baltimore, Md.
Hays Corp, 905 8th St, Michigan City, Ind.
Adv page 195
Manning, Maxwell & Moore, Inc, Bridgeport, Conn.
Meriam Co, W 112th St, Cleveland, Ohio
Peabody Engrg Corp, 580 5th Ave, New York, N. Y.
Adv page 140
Preferred Utilities Mfg Corp, New York, N. Y.
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Taylor Instrument Cos, Rochester, N. Y.
Uehling Instrument Co, 470 Getty Ave, Paterson, N. J.

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Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Crosby Steam Gage & Valve Co, 40 Church St, New York, N. Y.
Defender Automatic Regulator Co, St Louis, Mo.
Diamond Power Specialty Corp, Box 288, Detroit, Mich.
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Ernst Water Column & Gage Co, Livingston, N. J.
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Esterline-Angus Co, Box 596, Indianapolis, Ind.
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Adv page 138
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Adv page 131
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Klingerit, Inc, 16 Hudson St, New York, N. Y.
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Liquidometer Corp, 3616 Skillman Ave, Long Island City, N. Y.
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Adv pages 209, 254b
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, Ohio
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Morey & Jones, Ltd, 922 S Hemlock St, Los Angeles, Calif.
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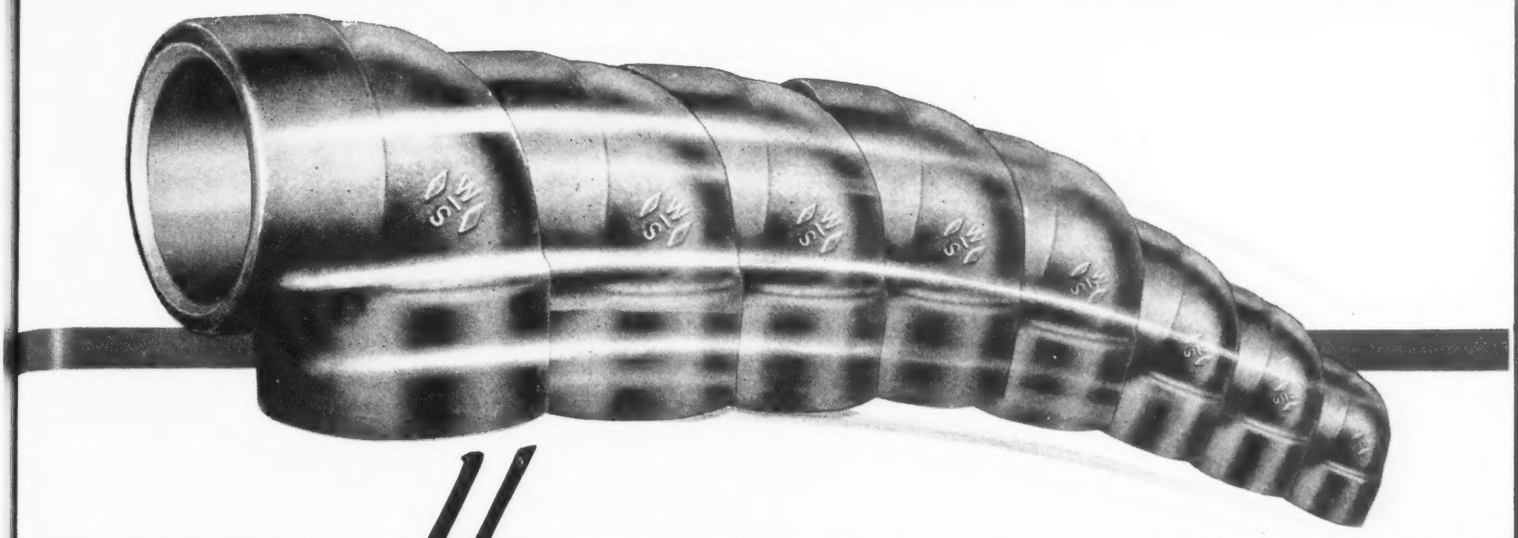

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Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
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Wright-Austin Co, Detroit, Mich.
Williams Gauge Co, 1620 Pennsylvania Ave, N S, Pittsburgh, Pa.
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Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.
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Bastian-Blessing Co, 4201 Peterson Ave, Chicago, Ill.
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
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Clark, Chas J, Blast Meter Co, Gladbrook, Iowa
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Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
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(See Welding)

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(See Detectors, Gas)

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(See Analyzers, CO_2, Portable, and Recorders, CO_2)

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(See Burners, Gas)

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Adv page 208
American Felt Co, 315 4th Ave, New York, N. Y.
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Anchor Packing Co, 401 N Broad St, Philadelphia, Pa.
Armstrong Cork Co, Industrial Div, Lancaster, Pa.
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Belmont Packing & Rubber Co, East Butler & Sepviva Sts, Philadelphia, Pa.
Booth Felt Co, 455 19th St, Brooklyn, N. Y.
Chicago Wilcox Mfg Co, 7701 Avalon Ave, Chicago, Ill.
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Crane Packing Co, 1801 Cuyler Ave, Chicago, Ill.
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Endura Mfg Corp, Quakertown, Pa.
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Goetze Gasket & Packing Co, 10 Allen Av, New Brunswick, N. J.
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Goodsell Packing Co, 1803 Belle Plaine Ave, Chicago, Ill.
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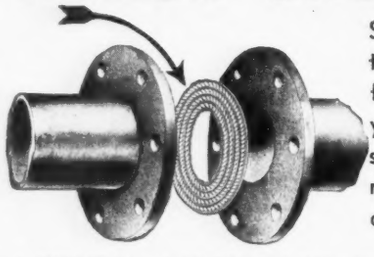

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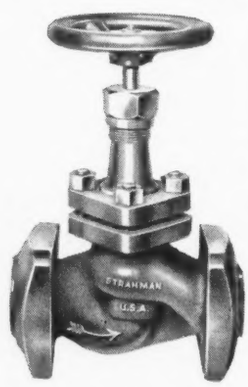

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Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
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Novo Engine Co, 1 Porter St, Lansing, Mich.
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Union Diesel Engine Co, 2200 E 7th St, Oakland, Calif.
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GLASS TUBING

(See Tubing, Glass)

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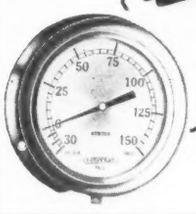

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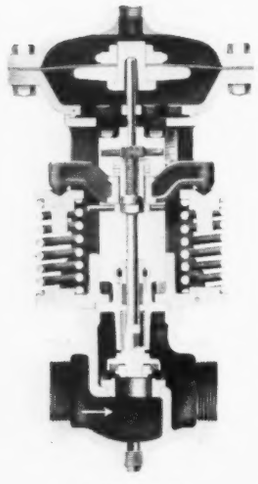

Type 37-P2

Type of Service	Type of Valve and Sizes	Materials of Construction	Initial Pressure and Temperature Range	Discharge Pressure Rating and Type	Differential Pressure Rating and Type
EXCESS PRESSURE SERVICE					
lower differential pressure ranges	37-P ½–4 in.	Semi-Steel Bronze Trim	250 lbs. 275° F.		10 to 110 lbs. Diaphragm Type
		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		50 to 150 lbs. Diaphragm Type
——Boiler Feed Pumps					
higher differential pressure ranges	37-P1 ½–4 in.	Semi-Steel Bronze Trim	250 lbs. 275° F.		100–300 lbs. Piston Type
		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		100–300 lbs. Piston Type
CONSTANT PRESSURE SERVICE lower discharge pressure ranges Fuel Oil Pumps Lube Oil Pumps Water Pumps Compressors	37-P2 ½–4 in.	Semi-Steel Bronze Trim	250 lbs. 475° F.	3–110 lbs. Diaphragm Type	
		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		
higher discharge pressure ranges not dead-end service	37-P3 ½–4 in.	Semi-Steel Bronze Trim	250 lbs. 475° F.	100–500 lbs. Piston Type	
Storage Tank Pumps		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		
differential or delayed action dead-end service	38-P4 ½–4 in.	Semi-Steel or Bronze Body with Bronze Trim	250 lbs. 475° F.	10–200 lbs. Diaphragm Type Auxiliary Operated	
		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		
closer regulation than with Types 37-P2 or P3 on widely and rapidly varying loads dead-end service FIRE PUMPS FUEL OIL PUMPS discharge above 100 lb.	38-P6 ½–4 in.	Semi-Steel or Bronze Body with Bronze Trim	250 lbs. 475° F.	10–800 lbs. Diaphragm Type Auxiliary Operated	
		Cast Steel Body Special Alloy Trim	300–400–600 lbs. 750° F.		
VACCUM SERVICE Vacuum Pumps	39-P10 ½–2 in.	Semi-Steel Bronze Trim	250 lbs. 475° F.	1 to 28 in. Hg. Vacuum Diaphragm Type	

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Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

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Bates, Walter, Co, 208 S La Salle St, Chicago, Ill.
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Carnegie-Illinois Steel Co, Pittsburgh, Pa.
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Hendrick Mfg Co, Carbondale, Pa.
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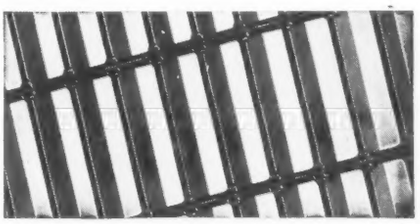

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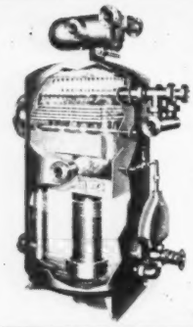

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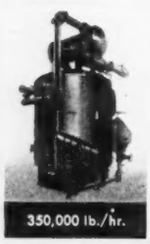

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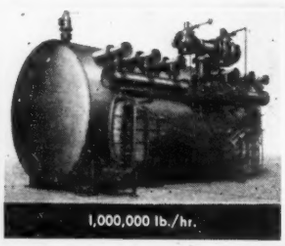

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Grinnell Co, Inc, 277 W Exchange St, Providence, R. I.
Adv page 141
Jarecki Mfg Co, Erie, Pa.
Kellogg, M W, Co, Jersey City, N. J.
Adv page 162
Limbert, Geo B, & Co, 570 Fulton St, Chicago, Ill.
National Valve & Mfg Co, 3102 Liberty Ave, Pittsburgh, Pa.
Adv page 271
Pittsburgh Valve & Fittings Corp, Barberton, Ohio
Rockwood Sprinkler Co, 54 Harlow St, Worcester, Mass.
Walworth Co, Inc, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159

HANGERS, SHAFT, & PILLOW BLOCKS

Ahlberg Bearing Co, 4732 Whipple St, Chicago, Ill.
American Pulley Co, 4200 Wissahickon Ave, Philadelphia, Pa.
Barry Co, Muscatine, Iowa.
Bartlett, C O, & Snow Co, Cleveland, Ohio
Bond, Charles, Co, 617-623 Arch St, Philadelphia, Pa.
Boston Gear Works, Inc, North Quincy, Mass.
Caldwell, W E, Co, 280 Brandeis St, Louisville, Ky.
Carey, W W, Co, Lowell, Mass.
Chicago Pulley & Shafting Co, Chicago, Ill.
Clizbe Bros Mfg Co, Plymouth, Ind.
Continental Gin Co, 4500 5th Ave, South, Birmingham, Ala.
Dick, R & J, Co, Passaic, N. J.
Dodge Mfg Corp, Mishawaka, Ind.
Falls Clutch & Machinery Co, Cuyahoga Falls, Ohio
Franklin Machine Co, Providence, R. I.
Goldens' Foundry & Machine Co, Columbus, Ga.
Great Western Mfg Co, Leavenworth, Kan.
H & O Machinery & Engrg Co, 281 Passaic St, Newark, N. J.
Hill Acme Co, 6400 Breakwater Ave, Cleveland, Ohio
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Jones, W A, Foundry & Machine Co, 4423 W Roosevelt Rd, Chicago, Ill.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Medart Co, 3548 De Kalb St, St Louis, Mo.
Palmer-Bee Co, Detroit, Mich.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Royersford Foundry & Machine Co, 75 Main, Royersford, Pa.
Sackett, A J, & Sons, Baltimore, Md.
S K F Industries, Inc, Front St & Erie Ave, Philadelphia, Pa.
Adv page 260
Smith, Winfield H, Inc, 330 West St, Springville, Ohio
Sprout, Waldron & Co, Muncy, Pa.
Standard Pressed Steel Co, Jenkintown, Pa.
Adv pages 197, 212
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

HEADS, EXHAUST

Atwood & Morrill Co, Salem, Mass.
Burt Mfg Co, 232 Main St, Akron, Ohio
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Hoppes Mfg Co, Belmont Ave, Springfield, Ohio
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Kieley & Mueller, Inc, 40 W 13th St, New York, New York
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Milwaukee Steam Appliance Co, West Allis, Wis.
Plouff Co, 1150 Columbus Ave, Boston, Mass.
Ruggles-Klingemann Mfg Co, Salem, Mass.
Sly, W W, Mfg Co, 4724 Train Ave, Cleveland, Ohio
Straight Line Foundry & Machine Corp, 218 S Geddes St, Syracuse, N. Y.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Wright-Austin Co, Detroit, Mich.

HEAT EXCHANGERS

Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Alco Products Div, 36 Church St, New York, N. Y.
Adv page 172
Andale Co, 1600 Arch St, Philadelphia, Pa.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Braun, C F & Co, 1000 South Fremont Ave, Alhambra, California.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Corning Glass Works, Dept IP, Corning, N. Y.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Devine, J P, Mfg Co, Inc, Mt Vernon, Ill.
Duriron Co, Inc, Dayton, Ohio
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
Adv page 238
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28

General Fittings Co, Providence, R. I.
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Heilman Boiler Works, Allentown, Pa.
Henszey Co, Dept D-14 Watertown, Wis.
Adv pages 183, 213, 220, 232
Hoppes Mfg Co, Belmont Ave, Springfield, Ohio
Kellogg, M W, Co, Jersey City, N. J.
Adv page 162
Leader Iron Works, Inc, Decatur, Ill.
Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kan.
Adv page 119
Marlo Coil Co, St Louis, Mo.
Patterson-Kelley Co, E Stroudsburg, Pa.
Pennsylvania Pump & Compressor Co, Easton, Pa.
Petroleum Iron Works Co, Sharon, Pa.
Prat-Daniel Corp, 80 S Water St, Port Chester, Pa.
Adv page 257
Rempe Co, 340 N Sacramento Blvd, Chicago, Ill.
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Ross Heater & Mfg Co, Inc, 1407 West Ave, Buffalo, N. Y.
Scaife, Wm B, & Sons Co, River & Ann St, Oakmont, Pa.
Schubert-Christy Corp, 1600 Georgia St, Affton Station, St Louis, Mo.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Staples & Pfeiffer Ltd, 528 Bryant St, San Francisco, Calif.
Stearns-Roger Mfg Co, Denver, Col.
Struthers-Wells Titusville Corp, Warren, Pa.
Treadwell Construction Co, Midland, Pa.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.
Worthington Pump and Machinery Corp, Harrison, N. J.
Yates American Machine Co, Beloit, Wis.
York Ice Machy Corp, York, Pa.
Zallea Bros & Johnson, 820 Locust St, Wilmington, Del.

HEAT-RESISTANT PAINTS

(See Paints, Heat-Resistant)

HEAT INSULATION

(See Insulation)

HEATERS, AIR

(See Preheaters, Air)

HEATERS, AIR, DIRECT-FIRED

Airtemp Div, Chrysler Corp, Dayton, Ohio
Campbell Heating Co, Des Moines, Iowa
Carrier Corp, Syracuse, N. Y.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Grand Rapids Blow Pipe & Dust Arrester Co, Grand Rapids, Mich.
Meyer Furnace Co, Peoria, Ill.
Palmers Mfg Corp, Phoenix, Ariz.
Ross, J O, Engrg Corp, New York, N. Y.

HEATERS, DEAERATING

Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Brownell Co, 301 N Findlay St, Dayton, Ohio
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Hoppes Mfg Co, Belmont Ave, Springfield, Ohio
Lummus Co, 420 Lexington Ave, New York, N. Y.
Permutit Co, Dept A, 330 West 42nd Street, New York, New York.
Adv page 125
Power Plant Specialty Co, 440 S Dearborn, Chicago, Ill.
Stearns-Roger Mfg Co, Denver, Colo.
Stickle Steam Specialties Co, 2217 Valley Ave, Indianapolis, Ind.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Worthington Pump & Machinery Corp, Harrison, N. J.

HEATERS, ENGINE-EXHAUST-GAS

American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Davis Engineering Corp, 1064-16 E Grand St, Elizabeth, N. J.

HEATERS, FEEDWATER

Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Alco Products Div, 36 Church St, New York, N. Y.
Adv page 172
Bass Foundry & Mach Co, Fort Wayne, Ind.
Braun, C F, & Co, 1000 S Fremont Ave, Alhambra, Calif.
Brownell Co, 301 N Findlay St, Dayton, Ohio
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Condenser Service & Engrg Co, 310 12th St, Hoboken, N. J.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Elliott Co, Jeannette, Pa.
Adv pages 8, 9
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Graver Tank & Mfg Co, Inc, East Chicago, Ind.
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Harrisburg Steel Corp, Harrisburg, Pa.
Hoppes Mfg Co, Belmont Ave, Springfield, Ohio
Johnson Corp, 865 Wood St, Three Rivers, Mich.
International Engrg Works Inc, Framingham, Mass.
Kroeschell Boiler Co, Racine, Wis.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Marshall Heater Co, Dayton, O.
Adv page 236
Milwaukee Reliance Boiler Works, Milwaukee, Wis.
Natural Gas Equipt Corp, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Patterson-Kelley Co, E Stroudsburg, Pa.
Petroleum Iron Works Div, Beaumont, Texas
Power Plant Specialty Co, 440 S Dearborn, Chicago, Ill.
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Stearns-Roger Mfg Co, Denver, Colo.
Stickle Steam Specialties Co, 2217 Valley Ave, Indianapolis, Ind.
Struthers-Wells Titusville Corp, Warren, Pa.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Watts Regulator Co, Lawrence, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.
Willamette Iron & Steel Corp, Portland, Ore.
Worthington Pump & Machinery Corp, Harrison, N. J.
Zallea Bros & Johnson 820 Locust St, Wilmington, Del.

HEATERS, OIL

Aeroil Burner Co, 5701 Park Ave, W New York, N. J.
Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
Alco Products Div, 36 Church St, New York, N. Y.
Adv page 172
American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
Andale Co, 1600 Arch St, Philadelphia, Pa.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Black, Sivalls & Bryson, Inc, Oklahoma City, Okla.
Braun, C F, & Co, 1000 S Fremont Ave, Alhamora, Calif.
California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
Coen Co, 40 Boardman Place, San Francisco, Calif.
Combustion Equipment Co, 1820 Cherry St, Kansas City, Mo.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Fittings Co, Providence, R. I.
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Hauck Mfg Co, 126 10th St, Brooklyn, N. Y.
Hynes Electric Heating Co, West & Clinton Sts, Camden, N. J.
Johnson, S T, Co, 940 Arlington, Oakland, Calif.
Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Lummus Co, 420 Lexington Ave, New York, N. Y.
Macleod Co, 2236 Bogen St, Cincinnati, Ohio
Mahr Mfg Co, Minneapolis, Minn.
McDermott Water Heaters, Inc, 514 Genesee St, Trenton, N. J.
National Airoil Burner Co, 1284 E Sedgley Ave, Philadelphia, Pa.
Patterson-Kelley Co, E Stroudsburg, Pa.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Purdue, Albert G, Associates, Inc, New Haven, Conn.
Ray Oil Burner Co, 401 Bernal Ave, San Francisco, Calif.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Schutte & Koerting Co, 12th & Thompson Sts, Phila., Pa.
Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Cal.
Struthers-Wells Titusville Corp, Warren, Pa.
Tate-Jones & Co, 23 Broad St, Leetsdale, Pa.
Trent, Harold E, Co, 55th & Wyalusing Ave, Philadelphia, Pa.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Vulcan Electric Co, 88-90 Holten St, Danvers, Mass.
Zallea Bros & Johnson, 820 Locust St, Wilmington, Del.

HEATERS, STRIP AND IMMERSION, ELECTRIC

American Foundry Equipment Co, Mishawaka, Ind.
Cutler-Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Hynes Electric Heating Co, West & Clinton Sts, Camden, N. J.
Trent, Harold E, Co, Philadelphia, Pa.
Vulcan Elec Co, 88-90 Holten St, Danvers, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wiegand, Edwin L, Co, Pittsburgh, Pa.

HEATERS, UNIT

Airtherm Mfg Co, 700 S Spring St, St Louis, Mo.
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Foundry & Equip Co, Mishawaka, Ind.
Bayley Blower Co, 1817 S 66 St, Milwaukee, Wis.
Bryant Heater Co, 17825 St Clair Ave, Cleveland, Ohio
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Burnham Boiler Corp, Irvington, N. Y.
Carrier Corp, Syracuse, N. Y.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Hastings Air Conditioning Co, Hastings, Neb.
Ilg Electric Ventilating Co, Chicago, Ill.
Industrial Mfg & Engrg Co, 3845 N Ravenswood Ave, Chicago, Ill.
Johnson Fan & Blower Corp, Dept P, 1319 W Lake, Chicago, Ill.
Kauffman Air Conditioning Corp, St Louis, Mo.
Kisco Co, 39th & Chouteau Ave, St Louis, Mo.
McCord Radiator & Mfg Co, Detroit, Mich.
McQuay, Inc, Minneapolis, Minn.
Marlo Coil Co, St Louis, Mo.

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This accurate instrument goes right in the pipe line. Simple in construction and principle of operation. There are no complicated parts to get out of order. If water passes through it must register. Indicates rate of flow of Steam, Water, Condensate, Gasoline, Light Oils, and Chemicals. Special model meets sanitary requirements for Milk and other Food Fluids. Sizes from 10 to 600 G.P.M. Connections ¾" to 4".

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Modine Mfg Co, Racine, Wis.
Murray, D J, Mfg Co, Wausau, Wis.
Murray Iron Works Co, Burlington, Iowa
Natural Gas Equipment, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Nelson, Herman, Corp, 1840 Horton Ave, Moline, Ill.
Nesbitt, John J, Inc, State Rd & Rhawn St, Philadelphia, Pa.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Palmers Mfg Co, Phoenix, Ariz.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Ross, J O, Engrg Corp, New York, N. Y.
Skinner Heating & Ventilating Co, 1990 N 9th, St Louis, Mo.
Sturtevant Co, B F, 47 Readville St, Hyde Park, Boston, Mass.
Surface Combustion Corp, Sieloff St, Toledo, Ohio
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
U. S. Radiator Corp, Detroit, Mich.
Vulcan Electric Co, 88-90 Holten St, Danvers, Mass.
Webster, Warren, & Co, Camden, N. J.
Adv page 247
Wiegand, Edwin L, Co, Pittsburgh, Pa.
Wing, L J, Mfg Co, W 14th St, & 7th Ave, New York, N. Y.
Adv page 182
Young Radiator Co, Racine, Wis.

HEATERS, WATER-SUPPLY

Aeroil Burner Co, 5701 Park Ave, W New York, N. Y.
Air Devices Inc, 17 E 42nd St, New York, N. Y.
Alberger Heater Co, 287 Chicago St, Buffalo, N. Y.
American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
American Radiator & Std Sanitary Corp, 40 W 40th St, New York, N. Y.
Andale Co, 1600 Arch St, Philadelphia, Pa.
Bell & Gossett Co, Chicago, Ill.
Birchfield Boiler Inc, Tacoma, Wash.
Bryant Heater Co, 17825 St Clair Ave, Cleveland, Ohio
Burnham Boiler Corp, Irvington, N. Y.
California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
Cox, Abram, Mfg Corp, Lansdale, Pa.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Eclipse Fuel Engrg Co, 707 So Main St, Rockford, Ill.
General Fittings Co, Providence, R. I.
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Hotstream Heater Co, Cleveland, Ohio
Johansen Water Heater Co, 817 W Webster Ave, Chicago, Ill.
Johnson Corp, 865 Wood St, Three Rivers, Mich.
Johnson, S T, Co, 940 Arlington, Oakland, Calif.
Kewanee Boiler Corp, Kewanee, Ill.
Littleford Bros, 457 E Pearl St, Cincinnati, Ohio
Adv page 185
Lookout Boiler Mfg Co, Chattanooga, Tenn.
Marion Machine Foundry & Supply Co, Marion, Ind.
Marshall Heater Co, Dayton, O.
Adv page 236
McDermott Water Heaters, Inc, 514 Genesee St, Trenton, N. J.
Pacific Steel Boiler Div, 1056 Natl Bank Bldg, Detroit, Mich.
Patterson-Kelly Co, E Stroudsburg, Pa.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Quaker City Iron Works, Philadelphia, Pa.
Ray Oil Burner Co, 401 Bernal Ave, San Francisco, Calif.
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Ross Heater & Mfg Co, 1409 West Ave, Buffalo, N. Y.
Sterling Engrg Co, Milwaukee, Wis.
Stover Steel Tank & Mfg Co, Freeport, Ill.
Taco Heaters, Inc, 342 Madison Ave, New York, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Triplex Htg Specialty Co, Peru, Ind.
Trent, Harold E, Co, 55th & Wyalusing Ave, Phila, Pa.
Vulcan Electric Co, 88-90 Holten St, Danvers, Mass.
Watts Regulator Co, Lawrence, Mass.
York Oil Burner Co, York, Pa.

HEATING SYSTEMS, HOT WATER

Airtemp Div, Chrysler Corp, Dayton, Ohio
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Radiator & Std Sanitary Corp, 40 W 40th St, New York, N. Y.
Burnham Boiler Corp, Irvington, N. Y.
California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Commodore Heaters Corp, 11 W 42nd St, New York, N. Y.
Hoffman Specialty Co, 1001 York St, Indianapolis, Ind.
Johnson, S T, Co, 940 Arlington Ave, Oakland, Calif.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Ross, J O, Engrg Corp, New York, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Triplex Heating Specialty Co, Peru, Ind.
York Oil Burner Co, York, Pa.

HEATING SYSTEMS, STEAM, VACUUM AND VAPOR

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Radiator & Std Sanitary Corp, 40 W 40th St, New York, N. Y.
Barnes & Jones Inc, 128 Brookside Ave, Jamaica Plain, Mass.
Burnham Boiler Corp, Irvington, N. Y.
Carrier Corp, Syracuse, N. Y.
Cashin, W D, Co, 69 A St, Boston, Mass.
Cox, Abram, Mfg Corp, Lansdale, Pa.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Gorton Htg Corp, Cranford, N. J.
Hoffman Specialty Co, 1001 York St, Indianapolis, Ind.
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Marsh, Jas P, Corp, 2049 Southport Ave, Chicago, Ill.
Monash-Younker Co, Inc. 1315 W Congress St, Chicago, Ill.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Tallmadge, Webster, & Co, 255 N 18th St, East Orange, N. J.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
U. S. Radiator Corp, Detroit, Mich.
Webster, Warren, & Co, Camden, N. J.
Adv page 247
York Oil Burner Co, York, Pa.

HEMP PACKING

(See Packing, Hemp)

HOISTS, HAND

Aeroil Burner Co, 5701 Park Ave, W New York, N. J.
American Chain Co, York, Pa.
Bartlett, C O, & Snow, Co, Cleveland, Ohio
Beebe Bros, Inc, 2724 Sixth Ave, S, Seattle, Wash.
Bridgeport Chain & Mfg Co, Bridgeport, Conn.
Chisholm-Moore Hoist Corp, 6015 Fremont Ave, Tonawanda, N. Y.
Cleveland Crane & Engrg Co, Wickliffe, Ohio
Conco Engrg Works, Mendota, Ill.
Ford Chain Block Div, American Chain & Cable Co, York, Pa.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Hall Mfg Co, Cedar Rapids, Iowa
Harrington Co, 17th & Callowhill Sts, Philadelphia, Pa.
McCollom Hoist & Mfg Co, Downers Grove, Ill.
Robbins & Myers, Inc, Springfield, Ohio
Ryerson, Jos T, & Sons, Inc, 16th & Rockwell Sts, Chicago, Ill.
Shaw-Box Crane & Hoist Div, Muskegon, Mich.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Union Mfg Co, New Britain, Conn.
Wright Mfg Div, American Chain & Cable Co, York, Pa.
Yale & Towne Mfg Co, Stamford, Conn.

HOISTS, ELECTRIC, PNEUMATIC

American Chain Co, York, Pa.
American Engrg Co, Aramingo Ave, Philadelphia, Pa.
Adv pages 16, 17
American Hoist & Derrick Co, St Paul, Minn.
Chisholm-Moore Hoist Corp, 6015 Fremont Ave, Tonawanda, N. Y.
Cleveland Crane & Engrg Co, Wickliffe, Ohio
Clyde Iron Works, Duluth, Minn.
Conco Engrg Works, Mendota, Ill.
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St Louis Mo.
Dake Engine Co, 633 Monroe St, Grand Haven, Mich.
Detroit Hoist & Machine Co, Detroit, Mich.
Dravo Corp, Pittsburgh, Pa.
Euclid Crane & Hoist Co, Euclid, Ohio
General Machinery Co, Spokane, Wash.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 202, 214, 220, 221, 236, 242, 254d
Harnischfeger Corp, Milwaukee, Wis.
Harrington Co, 17th & Callowhill Sts, Philadelphia, Pa.
Independent Pneumatic Tool Co, 600 W Jackson Blvd, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Lidgerwood Mfg Co, Elizabeth, N. J.
Louden Machinery Co, Fairfield, Iowa.
McCollum Hoist & Mfg Co, Downers Grove, Ill.
Northern Engrg Works, Detroit, Mich.
Novo Engine Co, 1 Porter St, Lansing, Mich.
O K Clutch & Machinery Co, Columbia, Pa.
Philadelphia Gear Works, Erie Ave & G St, Philadelphia, Pa.
Adv page 175
Robbins & Myers, Inc, Springfield, Ohio
Shaw-Box Crane & Hoist Div, Reading, Pa.
Shepard Niles Crane & Hoist Corp, 453 Schuyler Ave, Montour Falls, N. Y.
Stearns-Roger Mfg Co, Denver, Colo.
Stephens-Adamson Mfg Co 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Union Mfg. Co, New Britain, Ct.
Vulcan Iron Works, 750 S Main St, Wilkes-Barre, Pa.
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Philadelphia, Pa.
Willamette Iron & Steel Corp, Portland, Ore.
Wright Mfg Div, American Chain & Cable Co, York, Pa.
Yale & Towne Mfg Co, Stamford, Conn.

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Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Godfrey Conveyor Co, Dept A-77, Elkhart, Ind.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Lidgerwood Mfg Co, Elizabeth, N. J.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
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Palmer-Bee Co, Detroit, Mich.
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Adv page 168
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Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Webster Mfg Inc, Tiffin, Ohio

HOPPERS, COAL AND ASH

Alpha Tank & Sheet Metal Mfg Co, 5005 S 38th St, St Louis, Mo.
American Engrg Co, Aramingo Ave, Philadelphia, Pa.
Adv pages 16, 17
Bartlett, C O, & Snow Co, Cleveland, Ohio
Bergen Point Iron Works, Bayonne, N. J.
Bethlehem Steel Co, Bethlehem, Pa.
Bos-Hatten, Inc, Buffalo, N. Y.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.

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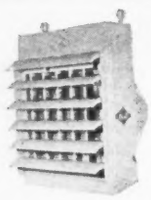

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Colonial Iron Works, 17643 St Clair Ave, Cleveland, Ohio
Connery Construction Co, 2nd & Luzerne Sts, Phila, Pa.
Adv page 184
Diamond Mfg Co, Wyoming, Pa.
Dover Boiler Works, 90 E Dickerson St, Dover, N. J.
Dravo Corp, Pittsburgh, Pa.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Hahn Engrg Div, 233 Broadway, New York, N. Y.
Adv page 194
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Leader Iron Works, Inc, Decatur, Ill.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Littleford Bros, 457 E Pearl St, Cincinnati, Ohio
Adv page 185
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Stearns-Roger Mfg Co, Denver, Colo.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Stock Engrg Co, 9805 Theodore Ave, Cleveland, Ohio
Stover Steel Tank & Mfg Co, Freeport, Ill.
Treadwell, M H, Co, 140 Cedar St, New York, N. Y.
Union Boiler & Mfg Co, 52 Vanderbilt Ave, New York, N. Y.
United Conveyor Corp, 37 W Van Buren St, Chicago, Ill.

HOSE, AIR

American Metal Hose Branch of American Brass Co, Waterbury, Conn.
Adv page 115
Anchor Packing Co, 401 N Broad St, Philadelphia, Pa.
Atlantic Metal Hose Co, 107 W 64th St, New York, N. Y.
Boston Woven Hose & Rubber Co, Cambridge, Mass.
Chicago Metal Hose Corp, 1312 S 3rd Ave, Maywood, Ill.
Adv page 273
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Cincinnati Rubber Mfg Co, 4901 Franklin Ave, Cincinnati, O.
Continental Rubber Works, Erie, Pa.
Elliott Co, Springfield, Ohio.
Adv pages 8, 9
Gates Rubber Co, 999 S Broadway, Denver, Colo.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, O.
Adv page 20
Hewitt Rubber Co, Buffalo, N. Y.
Independent Pneumatic Tool Co, 600 W Jackson, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Mulconroy Co, 54th & Jefferson Sts, Philadelphia, Pa.
N. Y. Belting & Packing Co, Passaic, N. J.
Pennsylvania Flexible Metallic Tubing Co, 7202 Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp, Comly & Milnor Sts, Philadelphia, Pa.
Republic Rubber Div, Lee Tire & Rubber Corp, Youngstown, Ohio
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Titeflex Metal Hose Co, Frelinghuysen Ave, Newark, N. J.
Westinghouse Air Brake Co, Wilmerding, Pa.

HOSE, FLEXIBLE METAL

(See Tubing, Flexible, Metal)

HOSE, FIRE

Continental Rubber Works, Erie, Pa.
Fabric Fire Hose Co, Sandy Hook, Conn.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, O.
Adv page 20
Hamilton Rubber Mfg Co, Trenton, N. J.
Hewitt Rubber Co, Buffalo, N. Y.
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
New York Belting & Packing Co, Passaic, N. J.
Quaker Rubber Corp, Comly & Milnor Sts, Philadelphia, Pa.
Republic Rubber Div, Lee Tire & Rubber Corp, Youngstown, Ohio
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
U. S. Rubber Co, 1230 6th Ave, New York, N. Y.

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American Metal Hose Branch of American Brass Co, Waterbury, Conn.
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Atlantic Metal Hose Co, Inc, 107 W 64th, New York, N. Y.
Continental Rubber Works, Erie, Pa.
Gates Rubber Co, 999 S Broadway, Denver, Colo.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, O.
Adv page 20
Hewitt Rubber Co, Buffalo, N. Y.
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Mulconroy Co, 54th & Jefferson Sts, Philadelphia, Pa.
New York Belting & Packing Co, Passaic, N. J.
Norgren, C A, Co, 210 Santa Fe Drive, Denver, Colo.
Pennsylvania Flexible Metallic Tubing Co, 7202 Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp, Comly & Milnor Sts, Phila, Pa.
Republic Rubber Div, Lee Tire & Rubber Corp, Youngstown, Ohio.
Seamlex Co, 5-21 48th Ave, Long Island City, N. Y.
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Titeflex Metal Hose Co, Frelinghuysen Ave, Newark, N. J.
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HOSE, STEAM

American Metal Hose Branch of American Brass Co, Waterbury, Conn.
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Atlantic Metal Hose Co, Inc, 107 W 64th St, New York, N. Y.
Chicago Metal Hose Corp, 1312 S Third Ave, Maywood, Ill.
Adv page 273
Cincinnati Rubber Mfg Co, 4901 Franklin, Cincinnati, O.
Continental Rubber Works, Erie, Pa.
Elliott Co, Springfield, Ohio.
Adv pages 8, 9
Gates Rubber Co, 999 S Broadway, Denver, Colo.
Goodrich, B F, Co, 460 S Main St, Akron, Ohio
Goodyear Tire & Rubber Co, 1144 E Market St, Akron, Ohio.
Adv page 20
Hewitt Rubber Co, Buffalo, N. Y.
Manhattan Rubber Mfg Div, 94 Townsend St, Passaic, N. J.
Mulconroy Co, 54th & Jefferson Sts, Philadelphia, Pa.
New York Belting & Packing Co, Passaic, N. J.
Pennsylvania Flexible Metallic Tubing Co, 7202 Powers Lane, Philadelphia, Pa.
Quaker Rubber Corp, Comly & Milnor Sts, Philadelphia, Pa.
Republic Rubber Div, Lee Tire & Rubber Corp, Youngstown, Ohio
Seamlex Co, 5-21 48th Ave, Long Island City, N. Y.
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Titeflex Metal Hose Co, Frelinghuysen Ave, Newark, N. J.
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Boston Coupling Co, Boston, Mass.
Boston Woven Hose & Rubber Co, Cambridge, Mass.
Cleveland Pneumatic Tool Co, Cleveland, Ohio
Continental Rubber Works, Erie, Pa.
Dallett Co, 165 W Clearfield St, Philadelphia, Pa.
Dayton Pneumatic Tool Co, 7 Norwood Ave, Dayton, Ohio
Dixon Valve & Coupling Co, Philadelphia, Pa.
Independent Pneumatic Tool Co, 600 W Jackson Blvd, Chicago, Ill.
Ingersoll-Rand, Co, 11 Broadway, New York, N. Y.
King Pneumatic Tool Co, N Ashland Ave, Chicago, Ill.
Mulconroy Co, 54th & Jefferson Sts, Philadelphia, Pa.
New York Belting & Packing Co, Passaic, N. J.
Norgren, C A, Co, 210 Santa Fe Drive, Denver, Colo.
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio
Ross Sprinkler Co, 34 Roberts St, Pasadena, Calif.
Sherman, H B, Mfg Co, Battle Creek, Mich.
Thermoid Rubber Div, Whitehead Rd, Trenton, N. J.
Westinghouse Air Brake Co, Wilmerding, Pa.

HUMIDIFIERS, CENTRAL PLANT

Air & Refrigeration Corp, New York, N. Y.
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Armstrong Machine Works, 812 Maple St, Three Rivers, Mich.
Adv pages 215, 230, 245, 249
Bahnson Co, Winston-Salem, N. C.
Barber Colman Co, Rockford, Ill.
Carrier Corp, Syracuse, N. Y.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Johnson Service Co, 507 E Michigan St, Milwaukee, Wis.
Niagara Blower Co, 6 E 45th St, New York, N. Y.
Parks-Cramer Co, Fitchburg, Mass.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Ross, J O, Engrg Corp, New York, N. Y.
Standard Engrg Works, Pawtucket, R. I.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.

HUMIDIFIERS, DIRECT, SPRAY HEAD

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Bahnson Co, Winston-Salem, N. C.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Carrier Corp, Syracuse, N. Y.
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
McDonnell & Miller, Rm 1305, Wrigley Bldg, Chicago, Ill.
Marley Co, Fairfax Road & Marley Ave, Kansas City, Kan.
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Parks-Cramer Co, Fitchburg, Mass.
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Adv pages 215, 230, 245, 249
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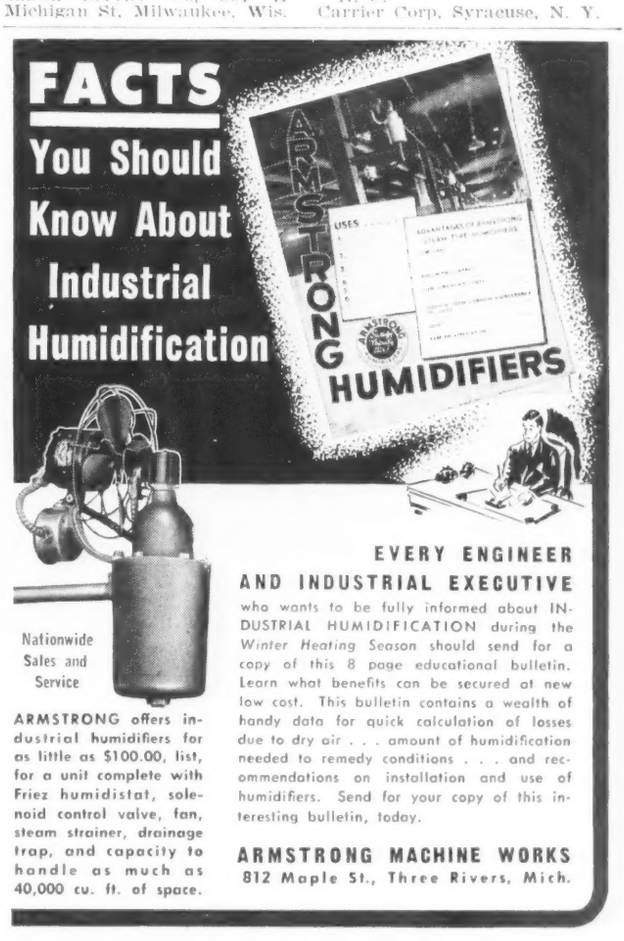
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Bristol Co, Waterbury, Conn.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Electric Tachometer Corp, Spring Garden St, Phila, Pa.
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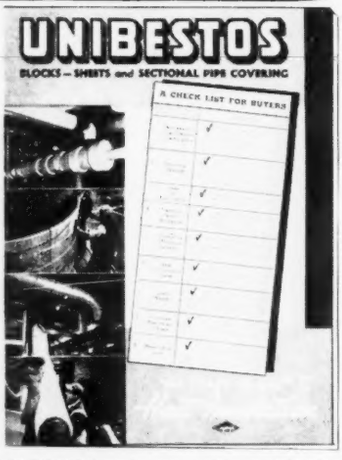

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Adv page 242
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

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Adv pages 212, 218, 238, 246
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Foster Engineering Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
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Adv pages 183, 213, 220, 232
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Adv pages 14, 15, 44, 45, 145
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.

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(See Smoke Indicators)

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Hancock Valve Div, Manning, Maxwell & Moore, 143 Elias St, Bridgeport, Conn.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Nathan Mfg Co, 250 Park Ave, New York, N. Y.
Ohio Injector Co, 150 Ohio Ave, Wadsworth, Ohio.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Sellers, William, & Co, 1600 Hamilton St, Philadelphia, Pa.

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Adv page 142
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Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Esterline-Angus Co, Box 596, Indianapolis, Ind.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
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Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d

Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
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Stewart-Warner Corp, 1826 Diversey Pkwy, Chicago, Ill.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheelco Instruments Co, 1929 S Halstead St, Chicago, Ill.
Adv page 243
Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

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Adv page 197
Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.
Adv pages 180, 186, 217
Botfield Refractories Co, 776-82 S Swanson St, Phila, Pa.
Adv page 232
Eagle-Picher Sales Co, 901 Temple Bar Bldg, Cincinnati, Ohio
Flintkote Co, 30 Rockefeller Plaza, New York, N. Y.
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Owens-Corning Fiberglas Corp, Toledo, Ohio
Ric-wiL Co, 1562 Union Commerce Bldg, Cleveland, Ohio
Adv page 270

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Armstrong Cork Co, Lancaster, Pa.
Adv page 197
Baldwin-Hill Co, 575 Klagg Ave, Trenton, N. J.
Adv pages 180, 186, 217
Barrett Co, 40 Rector St, New York, N. Y.
Carey, Philip, Mfg Co, Lockland, Ohio
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Ehret Magnesia Mfg Co, Inc, Valley Forge, Pa.
Adv page 50, 51
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Adv pages 48, 49
Keasbey & Mattison Co, Butler Pike, Ambler, Pa.
Adv page 178
Mexico Refract Co, Mexico, Mo.
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Adv pages 181, 232, 254c
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Adv page 192
Quigley Co, 56 W 45th St, New York, N. Y.
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Union Asbestos & Rubber Co, 1821 S 54th Ave, Cicero, Ill.
Adv pages 180, 216, 217, 248

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Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d

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Adv pages 54, 55

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Adv page 197
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Adv page 273
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Adv pages 48, 49
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Williams, J H, & Co, 225 Lafayette St, New York, N. Y.

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(See Condensers, Jet)

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Belfield, H, Co, 435 N Broad St., Philadelphia, Pa.
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Adv page 273
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Croll-Reynolds Engrg Corp, 17 John St, New York, N. Y.
Adv page 200
Delta-Star Electric Co, Fulton St, Chicago, Ill.
Dresser Mfg Co, Bradford, Pa.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
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Fulton Sylphon Co, Knoxville, Tenn.
Adv page 234
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Lunkenheimer Co, Box 360, Annex Station, Cincinnati, O.
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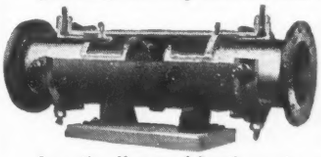
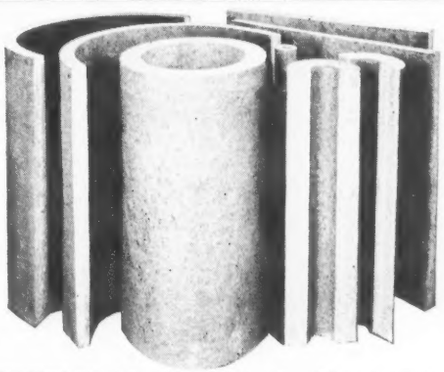


See other Yarway Advertisements on pages 103, 222, 252 and 254d
YARNALL-WARING COMPANY, 100 MERMAID AVE., PHILA.

UNIBESTOS



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CHICAGO—310 S. Michigan Ave. NEW YORK—420 Lexington Ave.
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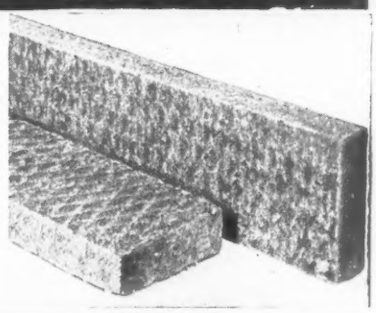
Contractor-Distributors Located in Principal Industrial Centers

B-H
HEAT INSULATION PRODUCTS
BALDWIN-HILL
MONO-BLOCK
Effective up to 1600° F

Covering the full range of temperatures up to 1600° F. with maximum efficiency, B-H MONO-BLOCK eliminates the need for 2 types of insulating block—one for low and one for high temperature. This block is preformed, fabricated of B-H chemically stable black rockwool fibres uniformly distributed, felted and bonded together to minimize heat flow. Made in sizes 18" and 36" long; 6", 12" and 18" wide; 1" to 4" thick.

Send for Catalog showing complete line.



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TRENTON, N. J.
Branch Offices: NEW YORK CHICAGO KALAMAZOO, MICH.

Send for this 52 page book
COCHRANE CORPORATION • 3106 N. 17th ST., PHILADELPHIA, PA.

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Adv page 273
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Johnson Corp, 865 Wood St, Three Rivers, Mich.
U S Pipe & Foundry Co, Burlington, N. J.
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Zallea Bros & Johnson, 820 Locust St, Wilmington, Del.

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Clow, James B, & Sons, 201-299 N Talman Ave, Chicago, Ill.
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Ad. page 109
Johnson Corp, 865 Wood St, Three Rivers, Mich.
Spraying Systems Co, 4021C W Lake St, Chicago, Ill.
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Bristol Co, Waterbury, Conn.
Clipper Belt Lacer Co, Front Ave, N W, Grand Rapids, Mich.
Crescent Belt Fastener Co, 247 Park Ave, New York, N. Y.
Detroit Belt Lacer Co, 3945-51 A St, Detroit, Mich.
Flexible Steel Lacing Co, 4607 Lexington St, Chicago, Ill.
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Pennwell Oil & Belting Co, 5 White St, New York, N. Y.
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Rhoads, J E & Sons, 35 N 6th St, Philadelphia, Pa.
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Schwartz Belting Co, 74 Murray St, New York, N. Y.
Talcott, W O & M W, Inc, 91 Sabin St, Providence, R. I.
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(See Also Scales)
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Beaumont-Birch Co, 1505 Race St, Philadelphia, Pa.
Bergen Point Iron Works, Bayonne, N. J.
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
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Caldwell, W E, Co, 280 Brandeis St, Louisville, Ky.
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Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Heilman Boiler Works, Allentown, Pa.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
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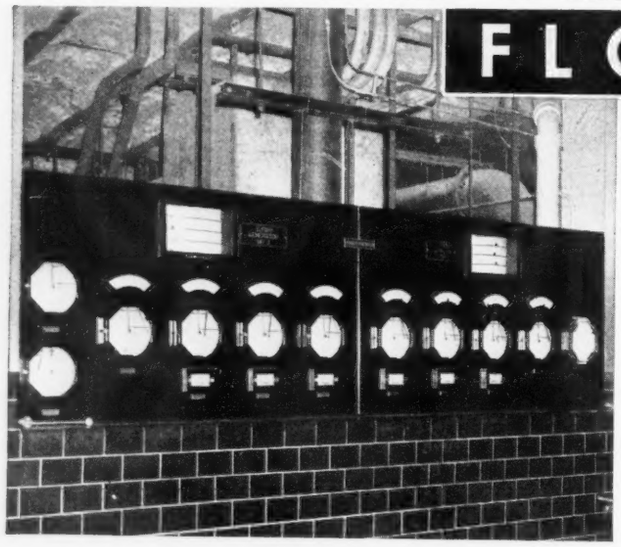
Richardson Scale Co, 690 Van Houten Ave, Clifton, N. J.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Stock Engrg Co, 9805 Theodore Ave, Cleveland, Ohio
Webster Mfg Inc, Tiffin, Ohio



FLOW METERS

For Measuring the Flow of Steam-Water-Gas-Air-Oil

Do you have a means for easily and quickly checking the production and distribution of these power plant services? Do you know how much you are paying for steam or how economically it is being used? Republic flow meters will give you all the production and maintenance information you need in order to detect leaks and improve methods.

WORKING PRESSURES
Republic meters are available for all working pressures up to 5000 lb. per sq. in.

RANGE EASILY CHANGED
The range of a Republic meter can be easily and quickly changed by merely changing the range tube.

READING INSTRUMENTS
The Republic indicator, recorder and integrator operate independently of each other and can be supplied separately or in combination. They are remote reading.

EASILY READ
The indicator scale and the recorder chart all have uniform graduations and are direct reading. The integrator has a large cyclometer type dial.

TYPICAL INSTALLATIONS

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MASONITE CORP.
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CONSOLIDATED GAS CO.
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FOR COMPLETE DETAILS WRITE FOR DATA BOOK No. 701

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Wellman Engrg Co, 7000 Central Ave, Cleveland, Ohio

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(See Packing, Leather)

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Excelsior Leather Washer Mfg Co, Rockford, Ill.
Garlock Packing Co, 400 Main St, Palmyra, N. Y.
Adv page 135
Graton & Knight Co, Worcester, Mass.
Himmelein & Bailey, Ins, 1300 Walnut St, Camden, N. J.
Houghton, E F, & Co, 244–250 W Somerset St, Phila, Pa.
Laurence Belting Co, 111 Chambers St, New York, N. Y.
Page Belting Co, Concord, N. H.
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Raniville, F, Co, Grand Rapids, Mich.
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Schieren, Chas A, Co, 30-39 Ferry St, New York, N. Y.
Watson-Stillman Co, Roselle, N. J.
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Williams, I B, & Sons, 73 Murray St, New York, N. Y.
Wayne Davies Packings, Inc, 325 W Huron St, Chicago, Ill.

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Laminated Shim Co, 61 Union St, Glenbrook, Conn.
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National Screw & Mfg Co, 2440 E 75th St, Cleveland, Ohio.
Palnut Co, 64 Cordier St, Irvington, N. J.
Positive Lock Washer Co, Ave A & Miller St, Newark, N. J.
Scovill Mfg Co, 99 Mill St, Waterbury, Conn.
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Standard Pressed Steel Co, Jenkintown, Pa.
Adv pages 197, 212

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(See Gages, Draft)

MECHANICAL TRANSMISSIONS

(See Gear Units, Transmissions)

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Esterline-Angus Co, Box 596, Indianapolis, Ind.

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(See Guns, Metal-Spray)

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Adv pages 26, 27
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Clark, Chas J, Blast Meter Co, Gladbrook, Iowa.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, 4 N Central Ave, Baltimore, Md.
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
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Roots-Connersville Blower Corp, Connersville, Ind.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Simplex Valve & Meter Co, 6780 Upland St, Philadelphia, Pa.

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Adv pages 26, 27
Stock Engrg Co, 9805 Theodore Ave, Cleveland, Ohio

METERS, CO_2

(See Analyzers, CO_2 and Recorders, CO_2)

METERS, CONDENSATION

American District Steam Co, 70 Bryant St, North Tonawanda, N. Y.
Adv page 134
Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
Henszey Co, Dept D-14, Watertown, Wis.
Adv pages 183, 213, 220, 232

METERS, FLOW

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American Meter Co, Inc, 60 E 42nd St., New York, N. Y.
Bacharach Industrial Instrument Co, 7000 Bennett, Pittsburgh, Pa.
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BUILDERS
RECORDING·INDICATING·CONTROLLING
Instruments
for
METERING FLOW
Liquid Level • Weight

VENTURI

Builders Venturi Meter is equally respected in boiler rooms, water works, and sewage disposal plants everywhere. For the super-accuracy required by central stations, each Type M is adjusted to match exactly its University-calibrated Venturi Tube. Write for Bulletin 324.

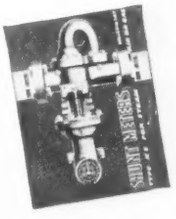
CHRONOFLO

Builders Chronoflo Telemeter brings measurements of flow, level, pressure, temperature, and weight from any distance to centrally located indicating and recording instruments. The Chronoflo time impulse Meter has more than fulfilled its promise. Write for Bulletin 320.

FLO-WATCH

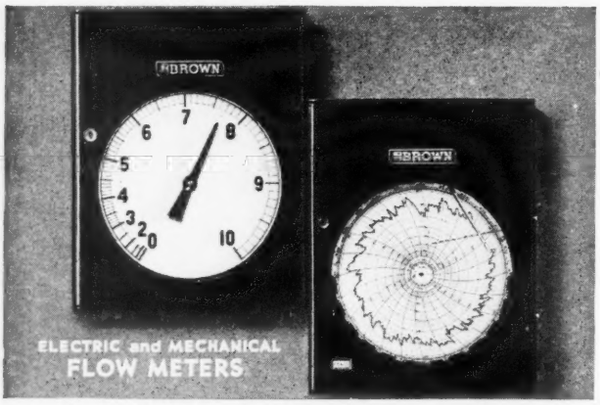
An attractive flow meter as accurate as it is good-looking. This recording, indicating, and totalizing meter is designed and priced to allow wide use throughout the plant. Equally serviceable with Venturi Tube, Flow Nozzle or Orifice Plate. Write for Bulletin 318A.

SHUNT



Again and again, hundreds of firms have purchased Builders Shunt Meters to measure steam, air, or gas that they sell to customers or distribute to various departments. Low price and accuracy are but two of the many Type KS advantages. Write for Bulletin 307.

BUILDERS - PROVIDENCE, INC.
(DIVISION OF BUILDERS IRON FOUNDRY)
14 CODDING STREET PROVIDENCE, R. I.



For Controlling, Recording, Totalizing and Indicating the Flow of Fluids such as Steam, Water, Gas, Oil, etc.

Brown Flow Meters are available in two types, the Electric type and Mechanical type.

ELECTRIC TYPE: Complete equipment consists of three units, the orifice plate, manometer and instrument. Instrument can be located at a remote point from the orifice and manometer (point of flow measurement).

Because of this flexibility, it is particularly adaptable for applications where instruments are to be remotely located. Write for Catalog 2007.

MECHANICAL TYPE: Complete equipment consists of two units, the orifice plate and the instrument. The meter body is integral with the instrument. Readings are transmitted mechanically from meter body to instrument. Write for Catalog 2204.

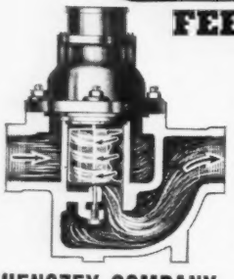
THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa.

BROWN Flow Meters

Accurate Measurement with Simplicity

HENSZEY

FEED WATER METER



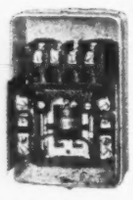
While primarily designed for feed water, this sturdy meter has been put to many different uses in various industries. Liquid, such as Condensate, Hot Dirty Water, Free Running Chemicals, etc. have been successfully measured with this instrument. Operates within 2% of absolute accuracy regardless of heat or dirt content of water. Also measures the flow of a reciprocating pump. Sizes, 10 to 1200 G.P.M. cold water steady flow. Connections ¾" to 6".

Send for literature.

HENSZEY COMPANY Dept. D14 Watertown, Wis.

MOTOR STARTERS

Graybar Quality Everything Electrical Graybar Electric Company



One Item of the Graybar 60,000

We have readily available the right control apparatus for every power requirement.

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Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
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Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

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Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
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Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
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Ellison Draft Gage Co, 214 W Kinzie St, Chicago, Ill.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, 4 N Central Ave., Baltimore, Md.
Republic Flow Meters Co, 2222 Diversey Parkway, Chicago, Ill.
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Simplex Valve & Meter Co, 6780 Upland St, Philadelphia, Pa.

METERS, WATER

Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
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Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
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(See Water Treatment, Mixers)

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Allis, Louis, Co, Milwaukee, Wis.
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Burke Electric Co, Erie, Pa.
Century Electric Co, 1806 Pine St, St Louis, Mo.
Crocker-Wheeler Electric Mfg Co, Ampere, N. J.
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Diehl Mfg Co, Elizabethport, N. J.
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Erie Electric Co, 124 Church St, Buffalo, N. Y.
Adv page 244
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Forbes & Myers, 174 Union St, Worcester, Mass.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
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Hanson-Van Winkle Munning Co, Matawan, N. J.
Ideal Electric & Mfg Co, Mansfield, Ohio
Janette Mfg Co, 556 W Monroe St, Chicago, Ill.
Reliance Electric & Engrg Co, 1068 Ivanhoe Rd, Cleveland, O.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
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Adv pages 54, 55

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Adv pages 11, 19, 37, 43
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Sterling Electric Motors Inc, Los Angeles, Calif.
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Adv pages 54, 55

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Adv pages 11, 19, 37, 43

Allis, Louis, Co, Milwaukee, Wis.
Barber Colman Co, Rockford, Ill.
Bogue Electric Co, 80 Glover Ave, Paterson, N. J.
Century Electric Co, 1806 Pine St, St Louis, Mo.
Crocker-Wheeler Elec Mfg Co, Ampere, N. J.
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Diehl Mfg Co, Elizabethport, N. J.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
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General Electric Co, Schenectady, N. Y.
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Howell Electric Motors Co, 671 Roosevelt St, Howell, Mich.
Janette Mfg Co, 556 W Monroe St, Chicago, Ill.
Reliance Electric Engineering Co, 1068 Ivanhoe Rd, Cleveland, Ohio
Sterling Electric Motors, Inc, Los Angeles, Calif.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
U S Electrical Motors, 200 E Slauson Ave, Los Angeles, Calif.
Wagner Electric Corp, St. Louis, Mo.
Wesche, B A, Electric Co, Cincinnati, Ohio
Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.
Adv pages 54, 55

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Barber Colman Co, Rockford, Ill.
Century Electric Co, 1806 Pine St, St Louis, Mo.
Diehl Mfg Co, Elizabethport, N. J.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
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Ohio Electric Mfg Co, 5938 Maurice Ave, Cleveland, Ohio
Star Electric Motor Co, Bloomfield, N. J.
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Sterling Electric Motors, Inc, Los Angeles, Calif.
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U S Electrical Motors, 200 E Slauson Ave, Los Angeles, Calif.
Wagner Electric Corp, St Louis, Mo.
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MOTORS, DC

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Allis, Louis, Co, Milwaukee, Wis.
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Diehl Mfg Co, Elizabethport, N. J.
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General Electric Co, Schenectady, N. Y.
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Continental Electric Co, 321 Ferry St, Newark, N. J.
Crocker-Wheeler Electric Mfg Co, Ampere, N. J.
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Delco Products, Dayton, Ohio.
Diehl Mfg Co, Elizabethport, N. J.
Electric Machinery Mfg Co, 1331 Tyler St, Minneapolis, Minn.
Elliott Co, Ridgeway, Pa.
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Erie Electric Co, 124 Church St, Buffalo, N. Y.
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Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
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Forbes & Myers, 174 Union St, Worcester, Mass.
General Electric Co, Schenectady, N. Y.
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Harnischfeger Corp, Milwaukee, Wis.
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Bayley Blower Co, 1817 S 66th St, Milwaukee, Wis.
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Deister Concentrator Co, Ft Wayne, Ind.
Eddington Metal Specialty Co, Box K, Eddington, Pa.
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Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
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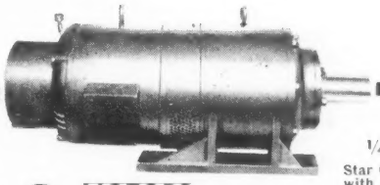

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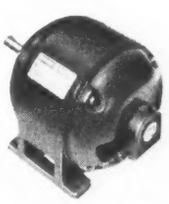

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Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
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Valvoline Oil Co, 547 E 5th St, Cincinnati, Ohio

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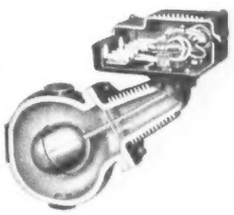

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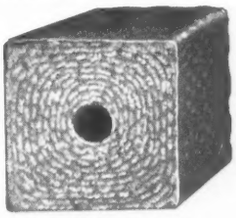

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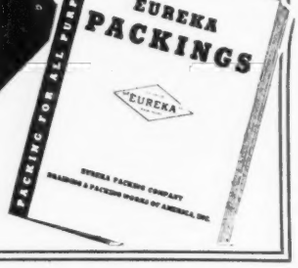

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Adv pages 158, 159

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Adv page 28
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Adv page 261
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Kellogg, M W, Jersey City, N. J.
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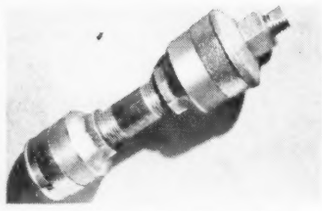

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for higher boiler-plant heat recovery

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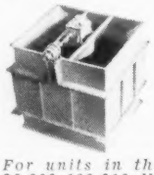

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General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
International Engrg Works, Inc, Framingham, Mass.
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, O.
Adv pages 30, 31
Nathan Mfg Co, 250 Park Ave, New York, N. Y.
Rockwood Sprinkler Co, 54 Harlow St, Worcester, Mass.
Sherman, H B, Mfg Co, Battle Creek, Mich.
Standard Valve Mfg Co, 817-21 Albany St, Boston, Mass.
Walworth Co, Inc, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159

PNEUMATIC CONVEYORS
(See Conveying Systems, Pneumatic)

PORTABLE CONVEYORS
(See Conveyors, Portable)

PRECIPITATORS, DUST, ELECTROSTATIC
American Air Filter Co, Louisville, Ky
Research Corp, 405 Lexington Ave, New York, N. Y.
Western Precipitation Co, 1016 W 9th St, Los Angeles, Calif.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

PREHEATERS, AIR
Air Preheater Corp, 60 E 42nd St, New York, N. Y.
Adv page 226
Airtherm Mfg Co, 700 S Spring Ave, St Louis, Mo.
American Locomotive Co, 30 Church St, New York, N. Y.
Adv pages 42, 172
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Combustion Equipment Co, 1820 Cherry St, Kansas City, Mo.
Edge Moor Iron Works, Inc, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Erie City Iron Works, 1422 East Ave, Erie, Pa.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Green Fuel Economizer Co, 627 Main St, Beacon, N. Y.
Adv pages 24, 25
Heilman Boiler Works, Allentown, Pa.
Keeler, E. Co, Williamsport, Pa.
Adv page 139
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Prat-Daniel Corp, 80 S Water St, Port Chester, N. Y.
Adv page 257
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Schubert-Christy Corp, 1600 Georgia St, Affton Station, St Louis, Mo.
Sturtevant, B F, Co, 47 Readville St, Hyde Park, Boston, Mass.
Surface Combustion Corp, Sieloff St, Toledo, Ohio
Union Iron Works, Erie, Pa.
Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.

PREHEATERS AND STRESS RELIEVERS, ELECTRIC
American Locomotive Co, 30 Church St, New York, N. Y.
Adv page 12
Hynes Electric Heating Co, West and Clinton Sts, Camden, N. J
Trent, Harold E, Co, Philadelphia, Pa.
Vulcan Electric Co, 88-90 Holten St, Danvers, Mass.

PRINTING MACHINES, BLUEPRINT, WHITEPRINT
Bruning, Charles, Co, 102 Reade St, New York, N. Y.
Ozalid Products Div, Johnson City, N. Y.

PSYCHROMETERS
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, 4 N Central Ave, Baltimore, Md.
Johnson Service Corp, 507 E Michigan St, Milwaukee, Wis.
Palmer Co, 2501-A Norwood Ave, Norwood, Cincinnati, Ohio
Parks-Cramer, Fitchburg, Mass.
Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.

PULLEYS, TRANSMISSION
Allis-Chalmers Mfg. Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Pulley Co, 4200 Wissahickon Ave, Philadelphia, Pa.
Barry Co, Muscatine, Iowa
Bartlett, C O, & Snow Co, Cleveland, Ohio
Caldwell, W E, Co, 280 Brandeis St, Louisville, Ky.
Carey, W W, Co, Lowell, Mass.
Diamond Iron Works Inc, Minneapolis, Minn.
Dick, R & J, Co, Colfax Ave, Passaic, N. J.
Dodge Mfg Corp, Mishawaka, Ind.
Falls Clutch & Machinery Co, Cuyahoga Falls, Ohio
Hill-Acme Co, 6400 Breakwater Ave, Cleveland, Ohio
Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Jones, W A, Foundry & Machine Co, 4423 W Roosevelt Rd, Chicago, Ill.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Medart Co, 3548 DeKalb St, St. Louis, Mo.
Reeves Pulley Co, Columbus, Ind.
Rockwood Mfg Co, 1801 English Ave, Indianapolis, Ind.

Schieren, Chas A, Co, 30-39 Ferry St, New York, N. Y.
Smith, Winfield, Inc, 330 West St, Springville, N. Y.
Standard Transmission Equip Co, 416 W 8th St, Los Angeles, Calif.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Wood's, T B, Sons Co, 1165 5th Ave, Chambersburg, Pa.

PULVERIZERS, COAL

Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bartlett, C O, & Snow Co, Cleveland, Ohio
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Erie City Iron Works, 1422 East Ave, Erie, Pa.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Strong-Scott Mfg Co, N W Terminal, Minneapolis, Minn.

PUMPING SYSTEMS, FUEL-OIL

American Marsh Pumps, 60 Capitol Ave, N E, Battle Creek, Mich.
Anthony Co, 47-33 5th St, Long Island City, N. Y.
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Byron Jackson Co, P O Box 2017 Terminal Annex, Los Angeles, Calif.
Columbus Steam Pump Works Co, Columbus, Ohio
Dean Brothers Co, Indianapolis, Ind.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Eddington Metal Specialty Co, Box K, Eddington, Pa.
Adv pages 221, 228
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Goulds Pumps, Inc, 301 Fall St, Seneca Falls, N. Y.
Granberg Equipment, Inc, 1308 67th St, Oakland, Calif.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.
Kraissl Co, Inc, Hackensack, N. J.
Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Leyman Mfg Corp, Cincinnati, Ohio
Monarch Mfg Works, 2731 E Westmoreland St, Phila, Pa.
National Airoil Burner Co, 1284 E Sedgley Ave, Philadelphia, Pa.
Quimby Pump Co, Inc, 347 Thomas St, Newark, N. J.
Roper, Geo D, Corp, Dept PD, Rockford, Ill.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Calif.
Sterling Pump Corp, Hamilton, Ohio
Tuthill Pump Co, 939 E 95th St, Chicago, Ill.
Viking Pump Co, 404 Decwer St, Cedar Falls, Iowa
Adv page 146
Worthington Pump & Machinery Corp, Harrison, N. J.

PUMP GOVERNORS

(See Governors, Pump)

PUMP VALVES

(See Valves, Pump)

PUMPS, CENTRIFUGAL

Aldrich Pump Co, Allentown, Pa.
Allen-Sherman-Hoff Co, 227 S 15th St, Philadelphia, Pa.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Marsh Pumps, 60 Capitol Ave N E, Battle Creek, Mich.
American Well Works, 100 N Broadway, Aurora, Ill.
Aurora Pump Co, 615 Loucks St, Aurora, Ill.
Barrett, Haentjens & Co, Hazleton, Pa.
Beach-Russ Co, 50 Church St, New York, N. Y.
Buffalo Pumps, Inc, 488 Broadway, Buffalo, N. Y.
Byron Jackson Co, P O Box 2017 Terminal Annex, Los Angeles, Calif.
Chicago Pump Co, 2336 Wolfram St, Chicago, Ill.
Coffin, J S, Jr, Co, Englewood, N. J.
Adv page 278
Columbus Steam Pump Works Co, Columbus, Ohio
Cook, A D, Inc, Lawrenceburg, Ind.
Dayton-Dowd Co, Quincy, Ill.
Dean Brothers Co, Indianapolis, Ind.
Dean Hill Pump Co, Anderson, Ind.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Deming Co, 500 Broadway, Salem, Ohio
Duriron Co, Inc, Dayton, Ohio
Economy Pumps, Inc, Hamilton, O.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Foster Pump Works, Inc, 50 Washington St, Brooklyn, N. Y.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Frederick Iron & Steel Co, Frederick, Md.
Adv page 142
Gardner-Denver Co, 100 Gardner Drive, Quincy, Ill.
Goulds Pumps, Inc, 301 Fall St, Seneca Falls, N. Y.
Goyne Steam Pump Co, Ashland, Pa.
Hills-McCanna Co, 3025 N Western Ave, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kimball Krogh Pump Corp, 301 West Ave 26, Los Angeles, Calif.
Kraissl Co, Hackensack, N. J.
Lawrence Pump & Engine Co, Lawrence, Mass.
Lewis, Chas S, & Co, Pine St at 22nd, St Louis, Mo.
Leyman Mfg Corp, Cincinnati, Ohio
Logansport Machine Inc, Logansport, Ind.
Micro-Westco, Inc, State St, Bettendorf, Iowa
Morris Machine Works, 100 E Genesee St, Baldwinsville, N. Y.
Nash Engrg Co, S Norwalk, Ct.
Novo Engine Co, 1 Porter St, Lansing, Mich.
Oliver United Filters, Inc, Oakland, Calif.
Pacific Pump Works, 5715 Bicket St, Huntington Park, Cal.
Pennsylvania Pump & Compressor Co, Easton, Pa.
Quimby Pump Co, Inc, 347 Thomas St, Newark, N. J.
Scranton Pump Mfg Co, Scranton, Pa.
Sterling Pump Corp, Hamilton, Ohio
Taber Pump Co, 286 Elm St, Buffalo, N. Y.
Union Steam Pump Co, Battle Creek, Mich.
Warren Steam Pump Co, 1234 Bridges Ave, Warren, Mass.
Weil Pump Co, 215-17 W Superior St, Chicago, Ill.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Weinman Pump Co, Columbus, O.
Wilson Snyder Mfg Div, Braddock, Pa.
Worthington Pump & Machinery Corp, Harrison, N. J.
Yeomans Bros Co, 1446 N Dayton St, Chicago, Ill.
Yuba Mfg Co, San Francisco, Calif.

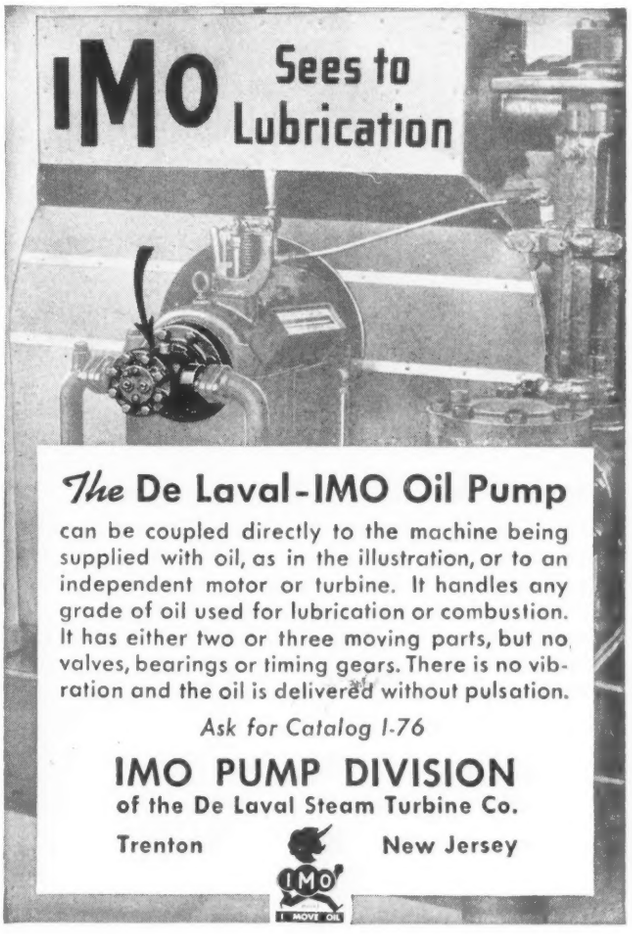
PUMPS, CONDENSATION-RETURN

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Buffalo Pumps, Inc, 488 Broadway, Buffalo, N. Y.
Byron Jackson Co, PO Box 2017, Terminal Annex, Los Angeles, Calif.
Columbus Steam Pump Works Co, Columbus, Ohio
Dayton-Dowd Co, Quincy, Ill.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Deming Co, 500 Broadway, Salem, Ohio
Domestic Engine & Pump Co, Shippensburg, Pa.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Economy Pumps, Inc, Hamilton, Ohio
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Hoffman Specialty Co, 1001 York St, Indianapolis, Ind.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Johnson Corp, 865 Wood St, Three Rivers, Mich.
Lawrence Pump & Engine Co, Lawrence, Mass.
Micro-Westco, Inc, State St, Bettendorf, Iowa
Nash Engineering Co, S Norwalk, Conn.
Quimby Pump Co, 347 Thomas St, Newark, N. J.
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Sterling, Inc, Milwaukee, Wis.
Sterling Pump Corp, Hamilton, O.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Warren Steam Pump Co, 1234 Bridges Ave, Warren, Mass.
Yeomans Bros Co, 1446 N Dayton St, Chicago, Ill.

PUMPS, DEEPWELL

American Marsh Pumps, 60 Capitol Ave, N E, Battle Creek, Mich.
American Well Works, 100 N Broadway, Aurora, Ill.
Aurora Pump Co, 615 Loucks St, Aurora, Ill.
Byron Jackson Co, P O Box 2017 Terminal Annex, Los Angeles, Calif.
Columbus Steam Pump Works Co, Columbus, Ohio
Cook, A D, Inc, Lawrenceburg, Ind.
Davidson, M T, Co, 154 Nassau St, New York, N. Y.
Deming Co, 500 Broadway, Salem, Ohio
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Goulds Pumps, Inc, 301 Fall St, Seneca Falls, N. Y.
Jarecki Mfg Co, Erie, Pa
Kimball-Krogh Pump Co, 326 West Ave 26, Los Angeles, Calif.
Layne & Bowler, Inc, Memphis, Tenn.
Leyman Mfg Corp, Cincinnati, Ohio
Micro-Westco, Inc, State St, Bettendorf, Iowa
Morris Machine Works, Baldwinsville, N. Y.
Pacific Pump Works, 5715 Bicket St, Huntington Park, Calif.
Peerless Pump Division, 301 West Ave 26, Los Angeles, Calif.
Pomona Pump Co, 206 E Commercial St, Pomona, Calif.
Adv page 229
Roper, Geo D, Corp, Dept P D, Blackhawk Park Ave, Rockford, Ill.
Sterling Pump Corp, Hamilton, Ohio
Worthington Pump & Machinery Corp, Harrison, N. J.

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Bowser, S F, & Co, 1302 E Creighton Ave, Fort Wayne, Ind.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Dayton-Dowd Co, Quincy, Ill.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Deming Co, 500 Broadway, Salem, Ohio
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.
Kraissl Co, Hackensack, N. J.
Lunkenheimer Co, P O Box 360, Annex Station, Cincinnati, Ohio
Adv pages 30, 31
Manzel Bros, Co, 326 Babock St, Buffalo, N. Y.
Micro-Westco, Inc, State St, Bettendorf, Iowa
Nathan Mfg Co, 250 Park Ave, New York, N. Y.
National Transit Pump & Machine Co, Oil City, Pa.
Pacific Pump Works, 5715 Bicket St, Huntington Park, Calif.
Quimby Pump Co, 347 Thomas St, Newark, N. J.
Roots-Connersville Blower Corp, Connersville, Ind.
Roper, Geo D, Corp, Dept PD, Blackhawk Park Ave, Rockford, Ill.
Roy, Milton, Pump Co, 1305 E Mermaid Ave, Chestnut Hill, Philadelphia, Pa.
Tuthill Pump Co, 939 E 95th St, Chicago, Ill.
Vickers, Inc, Detroit, Mich.
Viking Pump Co, 404 Decwer St, Cedar Falls, Iowa
Adv. page 146
Warren Steam Pump Co, 1234 Bridges Ave, Warren, Mass.
Wilson-Snyder Mfg Div, Oil Well Supply Co, Braddock, Pa.

PUMPS, PROPORTIONING

Bowser, S F, & Co, 1302 E Creighton Ave, Fort Wayne, Ind.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Hills-McCanna Co, 3025 N Western Ave, Chicago, Ill.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Manzel Bros Co, 326 Babcock St, Buffalo, N. Y.
Proportioneers, Inc, 7 Codding St, Providence, R. I.
Roy, Milton, Pump Co, 1305 E Mermaid Ave, Chestnut Hill, Philadelphia, Pa.

PUMPS, RECIPROCATING

Aldrich Pump Co, Allentown, Pa.
American Marsh Pumps, 60 Capitol, Battle Creek, Mich.
Baldwin-Southwark Div, Baldwin Locomotive Works, Paschall PO, Phila., Pa.
Buffalo Pumps, Inc, 488 Broadway, Buffalo, N. Y.
Columbus Steam Pump Works Co, Columbus, Ohio
Cook, A D, Inc, Lawrenceburg, Ind.
Davidson, M T, Co, 154 Nassau St, New York, N. Y.
Dean Brothers Co, Indianapolis, Ind.
Deming Co, 500 Broadway, Salem, Ohio
Dudgeon, Richard, Inc, 24 Columbia St, New York, N. Y.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Foster Pump Works, 50 Washington St, Brooklyn, N. Y.
Gardner-Denver Co, 100 Gardner Drive, Quincy, Ill.
Gaso Pump & Burner Mfg, Co, Tulsa, Okla.
Goulds Pumps, Inc, 301 Falls St, Seneca Falls, N. Y.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Leyman Mfg Corp, Cincinnati, Ohio
National Steam Pump Co, Upper Sandusky, Ohio
National Transit Pump & Mach Co, Oil City, Pa.
Pacific Pump Wks, 5715 Bicket St, Huntington Park, Calif.
Robertson, John, Co, 133 Water St, Brooklyn, N. Y.
Roper, Geo D, Corp, Dept PD, Blackhawk Park Ave, Rockford, Ill.
Roy, Milton, Pump Co, 1305 E Mermaid Ave, Chestnut Hill, Phila., Pa.
Scranton Pump Mfg Co, Scranton, Pa.
Union Steam Pump Co, Battle Creek, Mich.
Wagener Steam Pump Co, Canton, Ohio
Warren Steam Pump Co, 1234 Bridges Ave, Warren, Mass.
Watson-Stillman Co, Roselle, N. J.
Adv page 207
Wilson Snyder Mfg Div, Braddock, Pa.
Worthington Pump & Machinery Corp, Harrison, N. J.

PUMPS, ROTARY

Beach-Russ Co, 50 Church St, New York, N. Y.
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Bowser, S F, & Co, 1302 E Creighton Ave, Fort Wayne, Ind.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Deming Co, 500 Broadway, Salem, Ohio
Eddington Metal Specialty Co, Box K, Eddington, Pa.
Adv pages 221, 228
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Foster Pump Works, 50 Washington St, Brooklyn, N. Y.
Goulds Pumps, Inc, 301 Falls St, Seneca Falls, N. Y.
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Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.

EDCO VANE TYPE **ROTARY PUMPS**

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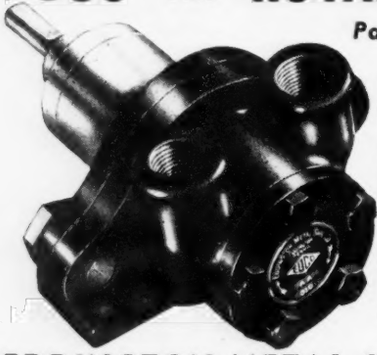

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Northern Pump Co, Minneapolis, Minn.
Oilgear Co, 1421 W Bruce St, Milwaukee, Wis.
Peerless Pump Div, 301 W 26 Ave, Los Angeles, Calif.
Quimby Pump Co, Inc, 347 Thomas St, Newark, N. J.
Roots-Connersville Blower Corp, Connersville, Ind.
Roper, Geo D, Corp, Dept PD, Blackhawk Park Ave, Rockford, Ill.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Taber Pump Co, 286 Elm St, Buffalo, N. Y.
Tuthill Pump Co, 939 E 95th St, Chicago, Ill.
Vickers Inc, Detroit, Mich.
Viking Pump Co, 404 Decwer St, Cedar Falls, Iowa
Adv page 146
Worthington Pump & Machinery Co, Harrison, N. J.

PUMPS, SUMP

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Manganese Steel Div, 397 E 14th St, Chicago Heights, Ill.
American Marsh Pumps, 60 Capitol Ave, Battle Creek, Mich.
Aurora Pump Co, 615 Loucks St, Aurora, Ill.
Buffalo Pumps, Inc, 488 Broadway, Buffalo, N. Y.
Byron Jackson Co, P O Box 2017 Terminal Annex, Los Angeles, Calif.
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Chicago Pump Co, 2336 Wolfram St, Chicago, Ill.
Columbus Steam Pump Works Co, Columbus, Ohio
Davidson, M T, Co, 154 Nassau St, New York, N. Y.
Dayton Pump & Mfg Co, Dayton, Ohio
Dean Brothers Co, Indianapolis, Ind.
Dean Hill Pump Co, Anderson, Ind.
De Laval Steam Turbine Co, Trenton, N. J.
Adv pages 52, 227
Deming Co, 500 Broadway, Salem, Ohio
Domestic Engine & Pump Co, Shippensburg, Pa.
Eastern Engrg Co, 45 Fox St, New Haven, Conn.
Economy Pumps, Inc, Hamilton, O.
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Frederick Iron & Steel Co, Frederick, Md.
Adv page 142
Goulds Pumps, Inc, 301 Fall St, Seneca Falls, N. Y.
Imperial Brass Mfg Co, 514 S Racine Ave, Chicago, Ill.
Independent Pneumatic Tool Co, 600 W Jackson Blvd, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kraissl Co, Hackensack, N. J.
Lawrence Pump & Engine Co, Lawrence, Mass.
Lewis, Chas S, Co, Pine & 22 Sts, St Louis, Mo.
Leyman Mfg Co, Cincinnati, Ohio
Mall Tool Co, 7740 S Chicago Ave, Chicago, Ill.
McGowan, John H, Co, Cincinnati, Ohio.
Micro-Westco, Inc, State St, Bettendorf, Iowa
Morris Machine Works, 100 E Genesee St, Baldwinsville, N. Y.
Nash Engrg Co, S Norwalk, Conn.
Peerless Pump Div, 301 West Ave 26, Los Angeles, Calif.
Pomona Pump Co, 120 Broadway, New York, N. Y.
Adv page 229
Quimby Pump Co, Inc, 347 Thomas St, Newark, N. J.
Roper, Geo D, Corp, Dept PD, Blackhawk Park Ave, Rockford, Ill.

Look for the noun in the product listing, for example:

"Pumps, Reciprocating"

not

"Reciprocating Pumps"

Sterling Pump Corp, Hamilton, Ohio
Taber Pump Co, 286 Elm St, Buffalo, N. Y.
Triplex Heating Specialty Co, Peru, Ind.
Union Steam Pump Co, Battle Creek, Mich.
Weil Pump Co, 215-17 W Superior St, Chicago, Ill.
Worthington Pump & Machinery Corp, Harrison, N. J.
Yeomans Bros, Co, 1446 N Dayton St, Chicago, Ill.

PUMPS, VACUUM

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Marsh Pumps, 60 Capitol Ave, Battle Creek, Mich.
Barrett, Haentjens & Co, Hazleton, Pa.
Beach-Russ Co, 50 Church St, New York, N. Y.
Bury Compressor Co, Erie, Pa.
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Chicago Pump Co, 2336 Wolfram St, Chicago, Ill.
Clark Bros Co, Olean, N. Y.
Columbus Steam Pump Works Co, Columbus, Ohio
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Davidson, M T, Co, 154 Nassau St, New York, N. Y.
Dean Brothers Co, Indianapolis, Ind.
Devine, J P, Mfg Co, Mt Vernon, Ill.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Economy Pumps Inc, Hamilton, Ohio
Foster Pump Works, Inc, 50 Washington St, Brooklyn, N. Y.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Fuller Co, 111 Bridge St, Catasauqua, Pa.
Gardner-Denver Co, 100 Gardner Drive, Quincy, Ill.
Gaso Pump & Burner Mfg Co, Tulsa, Okla.
Goulds Pumps, Inc, 301 Fall St, Seneca Falls, N. Y.
Goyne Steam Pump Co, Ashland, Pa.
Hoffman Specialty Co, 1001 York St, Indianapolis, Ind.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.
Kraissl Co, Hackensack, N. J.
Leyman Mfg Corp, Cincinnati, Ohio
Nash Engrg Co, S Norwalk, Conn.
Oliver United Filters, Inc, Oakland, Calif.
Pennsylvania Pump & Compressor Co, Easton, Pa.
Roots-Connersville Blower Corp, Connersville, Ind.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Stokes, F J, Machine Co, Olney P O, Philadelphia, Pa.
Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Tuthill Pump Co, 939 E 95th St, Chicago, Ill.
Union Steam Pump Co, Battle Creek, Mich.
Wagener Steam Pump Co, Canton, Ohio.
Warren Steam Pump Co, 1234 Bridges Ave, Warren, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

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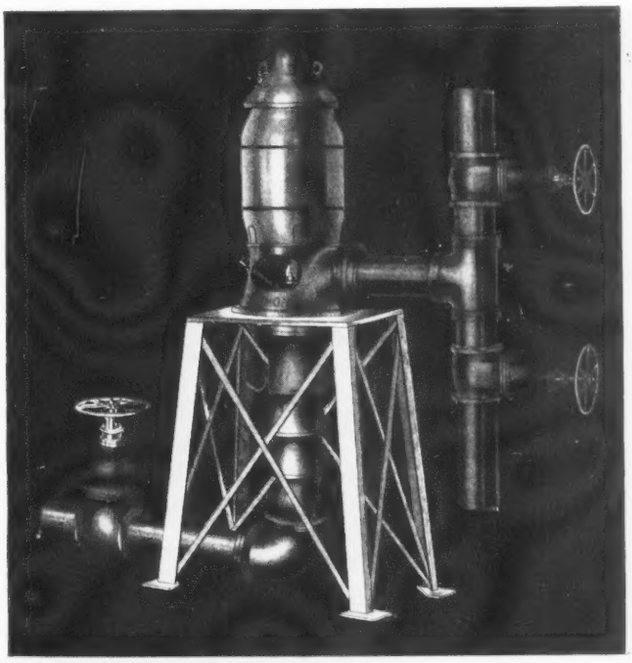
CLOSE COUPLED TURBINE PUMPS

Adaptable for condenser pumping, booster pumps, transfer pumps, circulation pumps, agitation pumps, vat and sump pumps, vacuum lift pressure pumps, vaco-process sinking pumps, caisson dewatering pumps, dredge transfer pumps, air conditioning pumps, wash water pumps for washing filters, water works and sewage treatment pumps, coal cleaning plant pumps, fire protection pumps, etc.

Open drive shaft construction (cold rolled, Monel, stainless, chrome plated, Herculoy, Yoloy, and special analysis steels); cutless rubber, Duprene or special bearings; self-lubricated by the fluid being pumped; semi-open impellers, adjustable capacity; bowls of Pomoloy iron, alloy iron, brass, the alloy bronzes or other special materials.

Sizes from 4 to 24 in.; from single stage to multi-staging; from 1½ hp. to 1000 hp.; capacities from 15 g.p.m. to 10,000 g.p.m.; for lifts against pressures up to 800 p.s.i.; for fluid temperatures to 180° F.

Write for Bulletin No. 29.



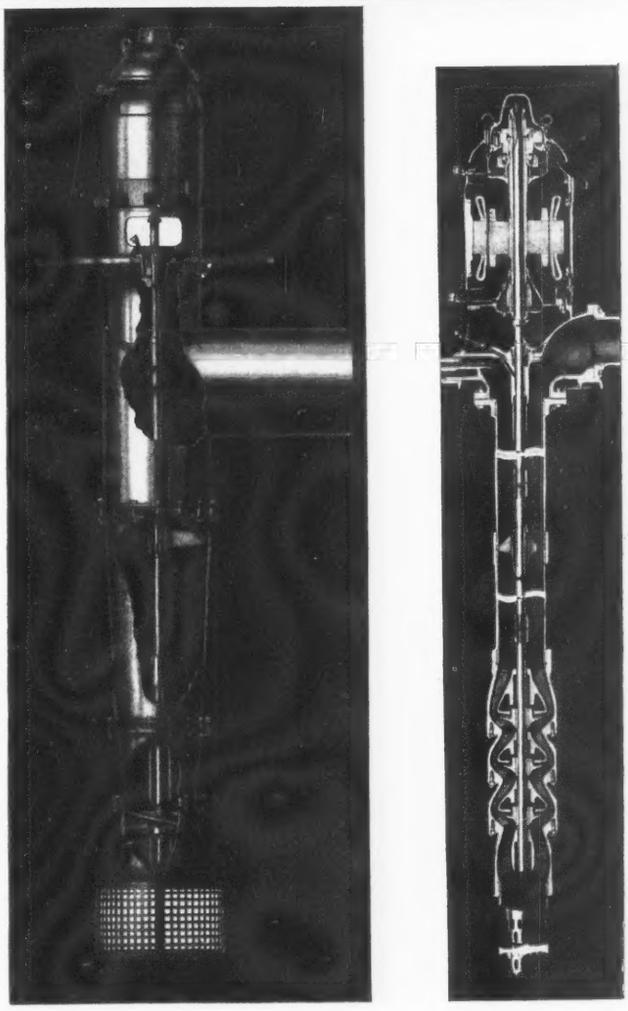
NIAGARA PROPELLER AND MIX FLOW PUMPS

Adaptable for condenser circulation and cooling, for transferring large volumes of liquids quickly, for washing and flushing processes (hot or cold), for agitating liquids and semi-liquids in process vats, for dry docks (main and trimming pumps), for pumping out caissons, for check and coffer dams, for storm water drainage, for treated sewage, for handling raw water from lakes and rivers into treating plants, for irrigation, flood control service or storm water drainage.

Shaft, bearing and bowl construction same type as Pomona Close Coupled Turbine Pumps and with varied material specifications to meet specific needs; fabricated column and directed flow type elbow from mild steel, Corten low alloy or other special corrosion resisting plate.

Definitely advantageous for large gallonage low lift operations; compact; no priming requirement. Available in two types —Niagara propeller for relatively low heads and Niagara mix-flow for lifts up to 90 ft. Niagara propeller has same characteristic as ship propeller and operates in bowl assembly with suitable guide vanes. Mix-flow bowl assembly has impeller possessing both axial flow and centrifugal component. Capacities range from 1,000 to 100,000 g.p.m.; for fluid temperatures to 180° F.

Write for Bulletin No. 28.



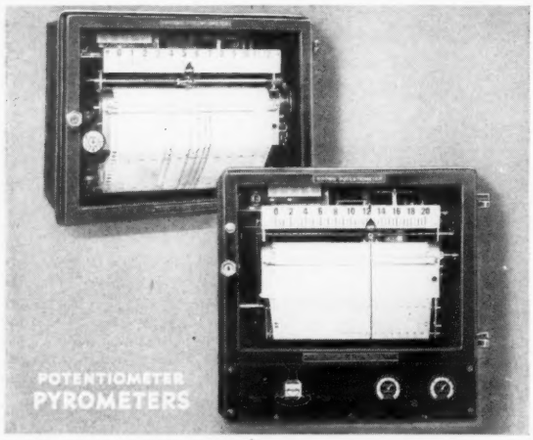
DEEP WELL TURBINE PUMPS

For primary water supply; for all industrial, municipal, mining and agricultural purposes. Adaptable as boosters; for circulation; cooling, air conditioning, fire protection and other similar purposes.

Open drive shaft construction; cutless rubber bearings revolving in patented precision bronze bearing retainers; water lubricated, assuring delivery of water at the pump head as clean and uncontaminated as at the bottom of the well; semi-open impellers, adjustable for capacity from the top of the pump; fully accessible above ground packing gland; bowls of Pomoloy high tensile strength cast iron; special column pipe and couplings made to precision specifications to assure correct alignment of pump shaft.

Sizes from 4 to 24 in. or larger; from single stage to multi-staging; from 1½ hp. to 1000 hp.; capacities from 15 g.p.m. to 10,000 g.p.m.; for lifts against pressures up to 800 p.s.i.; for temperatures to 180° F.

Write for Bulletin No. 26.



For Controlling, Recording and Indicating Temperatures from —150° F to +3200° F.

An extremely accurate and dependable instrument, designed and built for industrial service. Operating on the Potentiometer Principle, the instrument can be located practically any distance from the the point of temperature measurement (thermocouple location) without affecting its accuracy or dependability.

Charts and scales for a wide variety of ranges are available, from a minimum temperature span of 300°F. to a maximum span of 3000°F. Corresponding Centigrade scales and charts are also available.

Pyrometer accessories, such as thermocouples and extension lead wire, furnished with instruments to meet the individual requirements of each job.

Write for Catalog 1104. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa.

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To Measure and Control is to Economize

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Whittington, W P, & Co, Indianapolis, Ind.
Worthington Pump & Machinery Corp, Harrison, N. J.
Yeomans Bros Co, 1446 N Dayton St, Chicago, Ill.

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Adv pages 215, 230, 245, 249
York Ice Machinery Corp, York, Pa.

PURIFIERS, GAS

American Solvent Recovery Corp, Columbus, Ohio
Centrifix Corp, Dept P, 3029 Prospect Ave, Cleveland, O.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Koppers Co, Pittsburgh, Pa.

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Honan-Crane Corp, Lebanon, Ind.
Nugent, Wm, Co, 402 N Hermitage Ave, Chicago, Ill.
Youngstown-Miller Co, Sandusky, Ohio

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De Laval Separator Co, 165 Broadway, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Sharples Corp, Phila, Pa.
Skinner Purifiers Inc, 2231 Dalzelle St, Detroit, Mich.

PURIFIERS, STEAM

Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
International Filter Co, 325 W 25th Pl, Chicago, Ill.
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kan.
Adv page 119

PURIFIERS, WATER

American Doucil Co, 121-124 S 3rd St, Philadelphia, Pa.
American Water Softener Co, 4th & Lehigh Sts, Phila, Pa.
Bacharach, E W, & Co, Kansas City, Mo.
Chemical Solvent Co, Box 487, Birmingham, Ala.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
Adv page 238
Filtrators Co, Inc, 96 Liberty St, New York, N. Y.
Graver Tank & Mfg Co, Inc, East Chicago, Ind.
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
International Filter Co, 325 W 25th Place, Chicago, Ill.
Mohawk Water Treatment Co, Cleveland, Ohio
National Aluminate Corp, 6222 W 66th Place, Chicago, Ill.
Adv page 107
Permutit Co, Dept A, 330 W 42nd St, New York, N. Y.
Adv page 125
Scaife, Wm B, & Sons Co, River & Ann St, Oakmont, Pa.
Wallace & Tiernan Co, Belleville, N. J.
Wright-Austin Co, Detroit, Mich.

PYROMETERS

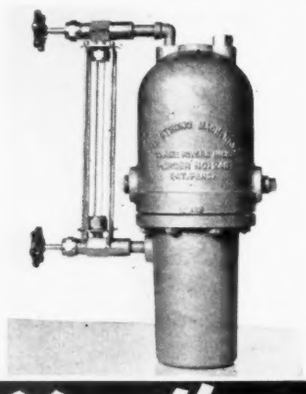
Bacharach Industrial Inst Co, 7000 Bennett, Pittsburgh, Pa.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244

Cut Your REFRIGERATION POWER COSTS

SAVE TIME — INCREASE SYSTEM CAPACITY

IF you are responsible for the operation of a compression type refrigeration system, we believe it will be well worth your while to know about the advantages offered by the new Armstrong Foul Gas Purger.

1. CUTS POWER COSTS—Records show reductions in head pressure of as much as 45 lbs. and power savings as high as 22% where purgers have been installed to remove foul gases.



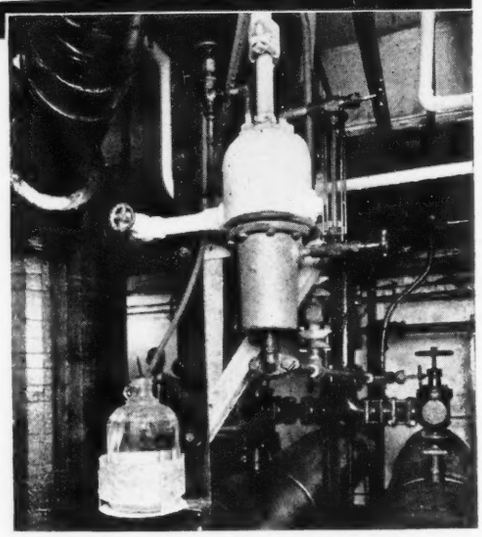
2. MINIMUM LOSS OF REFRIGERANT GAS—Condensation within Purger takes place at high side pressure, but at low side temperature.

3. AUTOMATIC—After starting the Armstrong Purger requires no attention until after the system is rid of air.

4. INCREASES COMPRESSOR CAPACITY—Every 4 lbs. reduction in head pressure increases compressor capacity approximately 1%!

5. LARGE CAPACITY—The No. 243 Purger shown here has been used successfully on systems ranging in size from 12 tons up to 1200 tons capacity. The unit lists at only $100.00. Savings quickly pay for it!

We will be glad to send you complete information. Write ARMSTRONG MACHINE WORKS, 812 Maple St., Three Rivers, Mich.



Abbott's Dairies, Inc., Cuts Pressure

The above picture shows the Armstrong Purger used on the 800-ton refrigeration system in the Philadelphia plant of Abbott's Dairies, Inc. The chief engineer reports condenser pressure cut by 15 to 20 lbs.

Use the new ARMSTRONG PURGER

Elmer & Amend, 635 Greenwich St, New York, N. Y.
Englehard, Charles, Inc, 234 N J RR Ave, Newark, N. J.
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Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
Adv page 2nd cover
Pyrometer Instrument Co, 103-A Lafayette St, New York, N. Y.
Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
Adv page 242
Tagliabue, C J, Mfg Co, Park & Nostrand, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Wheelco Instruments Co, 1929 S Halstead St, Chicago, Ill.
Adv page 243

RADIATOR VALVES

(See Valves, Radiator)

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G & O Mfg Co, New Haven, Conn.
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kan.
Adv page 119
Palmers Mfg Corp, Phoenix, Ariz.
Rome Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Weber Engine Co, 12th & Winchester Sts, Kansas City, Mo.
Young Radiator Co, Racine, Wis.

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Burnham Boiler Corp, Irvington, N. J.
Commodore Heaters Corp, 11 W 42nd St, New York, N. Y.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Fedders Mfg Co, 63 Tonawanda St, Buffalo, N. Y.
Grinnell Co, 227 W Exchange St, Providence, R. I.
Adv page 141
Hugo Mfg Co, West Duluth, Minn.
McCord Radiator & Mfg Co, E Grand Blvd, Detroit, Mich.
Nesbitt, John J, Inc, State Rd & Rhawn St, Philadelphia, Pa.
Pierce Butler Radiator Corp, 701 Nichols Ave, Syracuse, N. Y.
Rome-Turney Radiator Co, 200 Lynch St, Rome, N. Y.
Thatcher Furnace Co, 39-41 St Francis St, Newark, N. J.
Trane Co, 2012 Cameron Ave, LaCrosse, Wis.
Tuttle & Bailey Inc, New Britain, Conn.
U. S. Radiator Corp, Detroit, Mich.
Vulcan Radiator Co, Francis Ave, Hartford, Conn.
Webster, Warren, & Co, Camden, N. J.
Adv page 247
Young Radiator Co, Racine, Wis.

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Cornell-Dubilier Electric Corp, 1000 Hamilton, S Plainfield, N. J.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

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Bury Compressor Co, Erie, Pa.
California Steel Products Co, Barrett & A Sts, Richmond, Calif.
Chattanooga Boiler & Tank Co, Box 110, Chattanooga, Tenn.
Chicago Bridge & Iron Co, 2454 McCormick Bldg, Chicago, Ill.
Chicago Pneumatic Tool Co, 6-8 E 44th St, New York, N. Y.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St Louis, Mo.
Edge Moor Iron Works, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Farrar & Trefts, Inc, Buffalo, N. Y.
Hardie-Tynes Mfg Co, Birmingham, Ala.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Leader Iron Works, Decatur, Ill.
Milwaukee Reliance Boiler Works, Milwaukee, Wis.
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Pennsylvania Boiler Works, Erie, Pa.
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Petroleum Iron Works Div, Beaumont, Texas
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Pressed Steel Tank Co, S 66th St, Milwaukee, Wis.
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Sullivan Machinery Co, Michigan City, Ind.
Adv pages 190, 191
Titusville Iron Works Co, Titusville, Pa.
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Hays Corp, 905 Eighth St, Michigan City, Ind.
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Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
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Adv page 125
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b

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Adv pages 193, 199, 218, 254b

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Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
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Minneapolis-Honeywell Regulator Co, 2747 Fourth Ave S, Minneapolis, Minn.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, 95 Ames St, Rochester, N. Y.

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Adv pages 212, 218, 238, 246
Crosby Steam Gage & Valve Co, 40 Church St, New York, N. Y.
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Tagliabue, C J, Mfg Co, Park & Nostrand Ave, Brooklyn, N. Y.
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Adv pages 193, 199, 218, 254b
Tagliabue, C J, Mfg Co, Park & Nostrand Ave, Brooklyn, N. Y.
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General Electric Co, Schenectady, N. Y.
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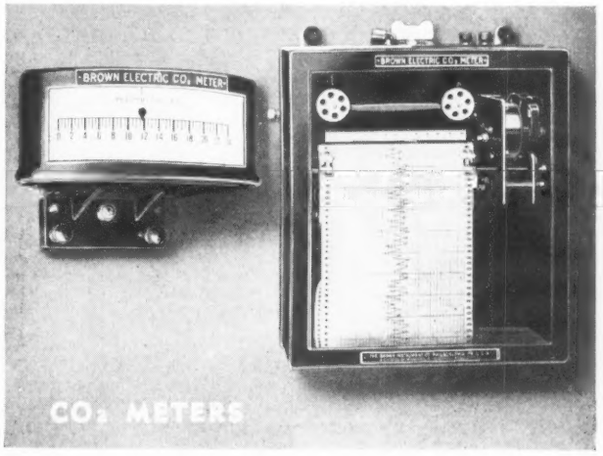
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d



For Recording and Indicating the Per Cent CO_2 in Flue Gas

Analyzes the flue gases electrically and then transmits the readings electrically to an indicating or recording meter, or both. No moving parts or chemicals in the gas analysis cell.

Furnished in three types for recording from one to six readings on a single chart, 7" wide. Single point recorders record the per cent CO_2 on a full width chart, using an inked ribbon. Multiple models record from two to three CO_2 readings on a full width chart using a multi-colored ribbon. Multiple duplex models, record from two to six readings on two sections of a full width chart, using two measuring systems and one multi-colored inked ribbon. Flue gas temperature can be recorded on same duplex chart with CO_2 reading. One, two or three temperatures and CO_2 readings can be recorded on the same duplex chart. Indicating reading is obtained directly on a 6" scale.

Write for Catalog 3006. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa.

BROWN ELECTRIC CO_2 METER

To Measure and Control is to Economize

BOTFIELD REFRACTORIES

—for low cost furnace maintenance

Adamant Fire Brick Cement

—a plastic ready mixed cement that air sets and maintains bond throughout entire temperature range. Has a P.C.E. of 3000° F. plus. Tests show Adamant has bonding strength of 800 lbs. per sq. in. at room temperature, 1270 lbs. per sq. in. at 2600° F.

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A superior refractory surfacing material that provides a brushed or sprayed coating to furnace walls which protects them from the attack of destructive elements. Shipped dry.

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World's Largest Makers of High Temperature Cements

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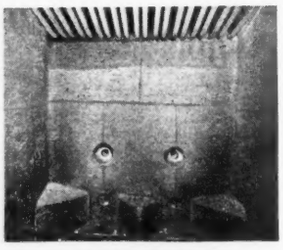
LASTS longer and gives more economical service than laid-up fire brick. Eliminates weak joints and loose brick; patented Flexo-Anchors prevent bulging. Saves fuel.

For patching, complete walls, full relining. Local Plibrico distributor will gladly quote on your repairs. Complete installation and boiler setting service in over 100 cities. Catalog free.



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BLUE FLAME
High temperature fire brick refractory. For laying up fire brick. Will flux ¼" back sealing joints. Can be fired while damp. May be applied to hot furnace. Resist errosive action of flame.

RED FLAME
High temperature veneer. Used on face of fire brick. Applied on all parts of furnace linings including arches, bridge walls, front walls, etc. For high temperature service only. Eliminates clinker trouble.

WHITE FLAME
Used where high insulating property is needed. Stands temperature of 2350° F.

WHITE-MONO
For tops of boilers. Readily adheres to iron and steel.

"KINGBOND"
For bonding fire brick walls and arches. Used for laying up refractory linings in all types of metallurgical furnaces, coke ovens, high pressure stills, rotary kilns, etc.

"PLASTIKADO"
For all types of boilers, heat treating, crucible melting, electric, oil and gas burning furnaces, gas retorts, etc. Will stand temperature of 3216° F.

MONO-BAFFLES

SANFORD C. SMITH REFRACTORIES, INC.

1715 NIAGARA ST. BUFFALO, N. Y.

HENSZEY

Goes Right In the Feed Line

BOILER FEED WATER REGULATOR

This simple, compact, self-contained unit goes right in the feed line—requires no additional structural support. It controls boiler water levels continuously and accurately under *all* load conditions. Once in operation there is nothing to get out of order—nothing to reset. Sizes for all pressures up to 600 lbs. Connections 1" to 4".

Send for literature.

HENSZEY COMPANY

Dept. D15 Watertown, Wis.

Hanson - Van Winkle - Munning Co, Matawan, N. J.
Schauer Machine Co, Cincinnati, Ohio
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

REDUCERS, SPEED

(See Gear Units, Transmissions)

REFRACTORIES

Acme Brick Co, Fort Wortn, Tex.
American Arch Co, 68 E 42nd St, New York, N. Y.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bernitz Furnace Appliance Co, 89 Broad St, Boston, Mass.
Botfield Refractories Co, 776-82 S Swanson St, Philadelphia, Pa.
Adv page 232
Brooklyn Firebrick Works, 88 Van Dyke St, Brooklyn, N. Y.
Carborundum Co, Dept P, Perth Amboy, N. J.
Carolina Refractories Co, Hartsville, S. C.
Chicago Fire Brick Co, 1463 Elston Ave, Chicago, Ill.
Denver Fire Clay Co, 2301 Blake St, Denver, Colo.
Detrick, M H, Co, 140 S Dearborn St, Chicago, Ill.
DeWolf Furnace Corp, 77 South Ave, Rochester, N. Y.
Adv page 254-c
Drake Non-Clinkering Furnace Block Co, Beekman St, New York, N. Y.
Electro Refractories & Alloys Corp, Andrews Bldg, Buffalo, N. Y.
Faulkner, J A, Refractories Co, W Federal St, Youngstown, O.
Furnace Economy Co, 201 N Wells St, Chicago, Ill.
General Refractories Co, 1600 Real Estate Trust Bldg, Philadelphia, Pa.
Green, A P, Fire Brick Co, 1020 Breckenridge, Mexico, Mo.
Harbison - Walker Refractories Co, 1800 Farmers Bank Bldg, Pittsburgh, Pa.
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Laclede-Christy Clay Products Co, 411 N 7th, St Louis, Mo.
Louisville Fire Brick Works, Inc, Louisville, Ky.
McLeod & Henry Co, Inc, 31 Monroe St, Troy, N. Y.
Mexico Refractories Co, Mexico, Mo.
Norton Co, Worcester, Mass.
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Pilbrico Jointless Firebrick Co, 1818 Kingsbury, Chicago, Ill.
Adv pages 181, 232, 254c
Pyro Clay Products Co, Oak Hill, Ohio
Quigley Co, 56 W 45th St, New York, N. Y.
Ramtite Co, 2563 W 18th St, Chicago, Ill.
Refractory & Insulation Corp, 381 4th Ave, New York, N. Y.
Reintjes, Geo P, Co, 2517 Jefferson St, Kansas City, Mo.
Seaboard Refractories Co, P O Box 151, Perth Amboy, N. J.
Smith, Sanford C, Refractories, 1715 Niagara St Buffalo, N. Y.
Adv page 232
U. S. Stoneware Co, 62 E 42 St, New York, N. Y.

REFRIGERATING SYSTEMS

Airtemp Div, Chrysler Corp, Dayton, Ohio
Baker Ice Machine Co, Inc, Omaha, Neb.
Carrier Corp, Syracuse, N. Y.
Croll-Reynolds Engrg Co, 17 John St, New York, N. Y.
Adv page 200
Curtis Pneumatic Machinery Co, 1934 Kien Ave, St Louis, Mo.
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
General Machinery Co, Riverside Ave, Spokane, Wash.
General Refrigeration Div, Yates-American Machine Co, Beloit, Wis.
Howe Ice Machine Co, 2821 Montrose Ave, Chicago, Ill.
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.
Richmond Engrg Co, 7th & Hospital Sts, Richmond, Va.
Ross Heater & Mfg Co, Inc, 1409 West Ave, Buffalo, N. Y.
Stearns-Roger Mfg Co, Denver, Colo.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.
Worthington Pump & Machinery Corp, Harrison, N. J.
York Ice Machy Corp, York, Pa.

REGULATING VALVES

(See Valves, Regulating)

REGULATORS, DAMPER

American Coal Burner Co, 155 E Superior St, Chicago, Ill.
Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Atlas Valve Co, 289 South St, Newark, N. J.
Adv page 250
Atwood & Morrill Co, Salem, Mass.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Barber Colman Co, Rockford, Ill.
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Defender Automatic Regulator Co, St. Louis, Mo.
Dunham, C A, Co, 405 E Ohio St, Chicago, Ill.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Field Mfg Co, 2328 Nelson Ave, Chicago, Ill.
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210 234, 253, 254a
Friez, Julian P, & Sons, 4 N Central Ave, Baltimore, Md.
General Regulator Corp, 165 Broadway, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Hays Corp, 905 E 8th St, Michigan City, Ind.
Adv page 195
Hoffman Specialty Co, 1001 York St, Indianapolis, Ind.
Hotstream Heater Co, Cleveland, Ohio
Illinois Engrg Co, Racine Ave, & 21st St, Chicago, Ill.
Johnson Service Co, 509 E Michigan St, Milwaukee, Wis.
Kieley & Mueller, Inc, 40 W 13th St, New York, N. Y.
Kitts Steam Specialty Co, 270 W Second St, Oswego, N. Y.
Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Leeds & Northrup Co, 4970 Stenton Ave, Phila, Pa.
Adv page 2nd cover
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv. page 309
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Penn Electric Switch Co, Goshen, Ind.
Power Turbo-Blower Co, 30 Vesey St, New York, N. Y.
Reading, Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Ruggles-Klingemann Mfg Co, Salem, Mass.
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Cal.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.

Triplex Heating Specialty Co, Peru, Ind.
Watts Regulator Co, Lawrence, Mass.

REGULATORS, ELECTRIC-CURRENT-DEMAND

Esterline-Angus Co, Box 596, Indianapolis, Ind.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Johnston & Jennings Co, 878 Addison Rd, Cleveland, Ohio
Adv page 131
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

REGULATORS, FEEDWATER

Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Atlas Valve Co, 289 South St, Newark, N. J.
Adv page 250
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Campbell, J A, Co, Long Beach, Calif.
Chaplin-Fulton Mfg Co, 28-40 Penn Ave, Pittsburgh, Pa.
Defender Automatic Regulator Co, St. Louis, Mo.
Eclipse Fuel Engrg Co, 707 S Main St, Rockford, Ill.
Fischer & Porter Co, 60 County Line Rd, Hatboro, Pa.
General Regulator Corp, 165 Broadway, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32 33, 149
Hennsey Co, Dept D-14, Watertown, Wis.
Adv pages 183, 213, 220, 232
Johnson Corp, 865 Wood St, Three Rivers, Mich.
Kieley & Mueller, Inc, 40 W 13th St, New York, N. Y.
Kitts Steam Specialty Co, 270 W 2nd St, Oswego, N. Y.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
McAlear Mfg Co, Chicago, Ill.
Adv page 233
McDonnell & Miller, Room 1305, Wrigley Bldg, Chicago, Ill.
Mercon Regulator Co, 2357 N 29th St, Milwaukee, Wis.
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Plouff Co, 1150 Columbus Ave, Boston, Mass.
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Squires, C E, Co, E 40th St & Kelley Ave, Cleveland, O.
Adv page 270
Stets Co, 141 Milk St, Boston, Mass.
Swartwout Co, 18501 Euclid Ave, Cleveland, Ohio
Adv page 310
Watts Regulator Co, Lawrence, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Williams Gauge Co, 1938 Pennsylvania Ave, N S, Pittsburgh, Pa.
Adv page 253
Wright-Austin Co, Detroit, Mich.

REGULATORS, FREQUENCY, ELECTRIC-GENERATOR

Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
Adv page 2nd cover
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

REGULATORS, LIQUID-LEVEL

Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Atlas Valve Co, 289 South St, Newark, N. J.
Adv page 250
Atwood & Morrill Co, Salem, Mass.
Automatic Control Co, 1005 University Ave, St Paul, Minn.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Bristol Co, Waterbury, Conn.
Brooke Engineering Co, Inc, 4517 Wayne Ave, Philadelphia, Pa.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Builders-Providence Inc, 7 Codding St, Providence, R. I.
Adv page 219
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Chaplin-Fulton Mfg Co, 28-40 Penn Ave, Pittsburgh, Pa.
Cochrane Corp, 3106 N 17 St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Defender Automatic Regulator Co, St Louis, Mo.
Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
Foster Engrg Co, 109 Monroe Ave, Newark, N. J.
Adv pages 210, 234, 253, 254a
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Controls Co, 810 Allen Ave, Glendale, Calif.
General Regulator Corp, 165 Broadway, New York, N. Y.
Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
Adv page 132
Griscom-Russell Co, 285 Madison Ave, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Johnson Corp, 865 Wood St, Three Rivers, Mich.
Johnson Service Co, 509 E Michigan St, Milwaukee, Wis.
Justus Steam Trap Co, Box 26, Napanoch, N. Y.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kieley & Mueller, Inc, 40 W 13th St, New York, N. Y.
Klipfel Mfg Co, 2651 W Harrison St, Chicago, Ill.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
McDonnell & Miller, Wrigley Bldg, Chicago, Ill.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Mercon Regulator Co, 2357 N 29th St, Milwaukee, Wis.
Natural Gas Equipment, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Penn Electric Switch Co, Goshen, Ind.
Photoswitch Inc, 21 Chestnut St, Cambridge, Mass.
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Ruggles-Klingemann Mfg Co, Salem, Mass.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Spence Engrg Co, Inc, 61 Grant St, Walden, N. Y.
Stets Co, 141 Milk St, Boston, Mass.
Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland, O.
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Adv page 310

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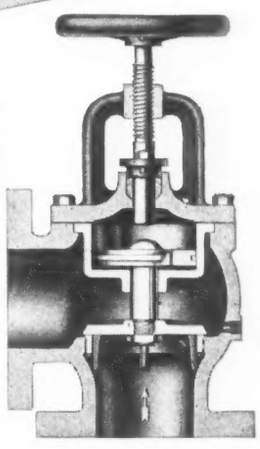

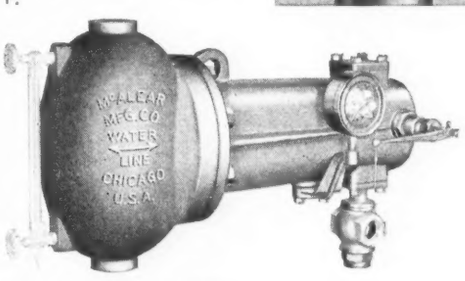

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FOR STEAM WORKING PRESSURES UP TO 400 LBS.

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Watts Regulator Co, Lawrence, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wright-Austin Co., Detroit, Mich.

REGULATORS, PRESSURE

Air Reduction Sales Co, 60 E 42nd St, New York, N. Y.
Adv pages 276, 277
Alco Valve Co, 2628 Big Bend Blvd, St Louis, Mo.
American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
American Meter Co, Inc, 60 E 42nd St, New York, N. Y.
Askania Regulator Co, S Michigan Ave, Chicago, Ill.
Atlas Valve Co, 289 South St, Newark, N. Y.
Adv page 250
Atwood & Morrill Co, Salem, Mass.
Automatic Control Co, 1005 University Ave, St Paul, Minn.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Bastian-Blessing Co, 4201 Peterson Ave, Chicago, Ill.
Bell & Gossett Co, Chicago, Ill.
Bristol Co, Waterbury, Conn.
Brooke Engineering Co, Inc, 4517 Wayne Ave, Philadelphia, Pa.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Chaplin-Fulton Mfg Co, 28-40 Penn Ave, Pittsburgh, Pa.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
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Defender Automatic Regulator Co, St. Louis, Mo.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Fulton Sylphon Co, Knoxville, Tenn.
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General Regulator Corp, 165 Broadway, New York, New York.
Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
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Grove Regulator Co, 1190 67th St, Oakland, Calif.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
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Hays Corp, 905 8th St, Michigan City, Ind.
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Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Johnson Service Co, 507 E Michigan St, Milwaukee, Wis.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kieley & Mueller, Inc, 40 W 13th St, New York, N. Y.
Klipfel Mfg Co, 2651 W Harrison St, Chicago, Ill.
Leslie Co, Lyndhurst, N. J.
McAlear Mfg Co, Chicago, Ill.
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Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mercon Regulator Co, 2357 N 29th St, Milwaukee, Wis.
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 4490 Wayne Ave, Philadelphia, Pa.
Natural Gas Equipment, Inc. 539 Petroleum Bldg, Los Angeles, Calif.
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Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
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Penn Electric Switch Co, Goshen, Ind.
Plouff Co, 1150 Columbus Ave, Boston, Mass.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Reading-Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Ruggles-Klingemann Mfg Co, Salem, Mass.
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Shallcross Controls, Inc, 121 N Broadway, Milwaukee, Wis.
Spence Engrg Co, Inc, 61 Grant St, Walden, N. Y.
Squires, C E, Co, E 40th St & Kelley Ave, Cleveland, Ohio
Adv page 270
Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Calif.
Strong, Carlisle & Hammond Co, 1392 W 3rd, Cleveland, O.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Waters Governor Co, 1123 Oliver Bldg, Boston, Mass.
Watts Regulator Co, Lawrence, Mass.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Wheelco Instruments Co, 1929 S Halstead St, Chicago, Ill.
Adv page 243
York Ice Machy Corp, York, Pa.

REGULATORS, SPEED, ELECTRIC-MOTOR

Allen-Bradley Co, Milwaukee, Wis.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Cutler-Hammer Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
Adv pages 193, 199, 218, 254b
Ward Leonard Electric Co, 31 South St, Mt Vernon, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

REGULATORS, TEMPERATURE

Atlas Valve Co, 289 South St, Newark, N. J.
Adv page 250
Automatic Temperature Control Co, Germantown Ave & Logan St, Philadelphia, Pa.
Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
Adv pages 26, 27
Barber-Colman Co, Rockford, Ill.
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Burling Instrument Co, 253 Springfield Ave, Newark, N. J
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Defender Automatic Regulator Co, St Louis, Mo.
Eastern Engineering Co, 45 Fox St, New Haven, Conn.
Edison, Thomas A, West Orange, N. J.
Engelhard, Charles, Inc, 234 N J RR Ave, Newark, N. J.
Fenwal Inc, 100 Main St, Ashland, Mass.
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
Friez, Julien P, & Sons, Inc, 4 N Central, Baltimore, Md.
Fulton Sylphon Co, Knoxville, Tenn.
Adv page 234
General Controls Co, 810 Allen Ave, Glendale, Calif.
General Regulator Corp, 165 Broadway, New York, N. Y.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Jefferson Electric Co, Bellwood, Ill.
Johnson Service Co, 509 E Michigan St, Milwaukee, Wis.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kieley & Mueller, Inc, 40 W 13th St, New York, N. Y.
Klipfel Mfg Co, 2651 W Harrison St, Chicago, Ill.
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
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Leslie Co, Lyndhurst, N. J.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Marsh Tritrol Co, Chicago, Ill.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
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Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Penn Electric Switch Co, Goshen, Ind.
Powers Regulator Co, 2771-2 Greenview Ave, Chicago, Ill.
Reading-Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
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Ruggles-Klingemann Mfg Co, Salem, Mass.
Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36

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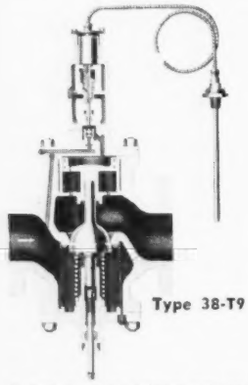

Type 38-T9

Type	Service	Action	Regulation Approx. Deg. Fahr.	Working Pressures Lbs. per Sq. In. Min.	Working Pressures Lbs. per Sq. In. Max.	Ranges of Temp. Adjustment, Deg. Fahr.	Sizes, In.	Connections
37-T4	Dead-end	Direct throttling	±1-3	5	250	(0–100) (50–160) (90–200) (140–250) (190–300)	¼, ⅜, ½	¼, ⅜, ½ Screwed
34-T2	Continuous flow	Direct throttling	±2-4	0	125	(40– 80) (70–110) (100–140) (120–160) (130–170) (140–180) (160–200)	½ to 1½	½ to 1½ Screwed 1 to 1½ Flanged
37-T3	Continuous flow	Direct throttling	±2-5	0	50	(0–100) (50–160) (90–200) (140–250) (190–300)	2 to 8	1 to 3 Screwed 2 to 8 Flanged
34-T	Dead-end	Pilot intermittent	±1	10	200	(0–110) (50–160) (90–200) (140–250) (190–300)	½ to 2	½ to 2 Screwed 1 to 2 Flanged
38-T9	Intermittent and dead-end	Pilot throttling	±1	30	250	(0–100) (50–160) (90–200) (140–250) (190–300)	½ to 8	½ to 4 Screwed 1¼ to 12 Flanged

Ranges of temperature adjustment other than those shown will be furnished on request.

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Sterling Inc, Milwaukee, Wis.
Tagliabue, C J, Mfg Co, Park & Nostrand, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Wheelco Instruments Co, 1929 Halstead St, Chicago, Ill.
Adv page 243

REGULATORS, VOLTAGE

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Electric Machinery Mfg Co, 1331 Tyler St, N E, Minneapolis, Minn.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Ward Leonard Electric Co, 31 South St, Mt Vernon, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

RELAYS, ELECTRIC

Allen-Bradley Co, Milwaukee, Wis.
Autocall Co, Shelby, Ohio
Automatic Temperature Control Co, Inc, Germantown Ave & Locust St, Philadelphia, Pa.
Automatic Switch Co, 41 E 11 St, New York, N. Y.
Cutler Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
Edison, Thomas A, West Orange, N. J.
Ess Instrument Co, 30 Irving Pl, New York, N. Y.
Esterline-Angus Co, Box 596, Indianapolis, Ind.
Friez, Julian P, & Sons, 4 North Central Ave, Baltimore, Md.
General Controls Co, 810 Allen Ave, Glendale, Calif.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
Penn Electric Switch Co, Goshen, Ind.
Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
Adv page 242
Signal Engrg & Mfg Co, 161 W 14th St, New York, N. Y.
Ward Leonard Electric Co, 31 South St, Mt Vernon, N. Y.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

RELIEF VALVES

(See Valves, Relief)

REPAIR WORK, BOILER

Bigelow Co, 200-22 River St, New Haven, Conn.
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Brownell Co, 301 N Findlay St, Dayton, Ohio
California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
Dover Boiler Works, 90 E Dickinson St, Dover, N. J.
General Machinery Co, Riverside Ave, Spokane, Wash.
Hodge Boiler Works, East Boston, Mass.
Kroeschell Boiler Co, Racine, Wis.
Marshall Heater Co, Dayton, O.
Adv page 236
Webster, Howard J, Greene & Hortter Sts, Philadelphia, Pa.

REPAIR WORK, CHIMNEY

American Chimney Co, 147 4th Ave, New York, N. Y.
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Continental Chimney Co, 127 N Dearborn St, Chicago, Ill.
Custodis, Alphons, Chimney Const Co, 80 Broad St, New York, N. Y.
Cutshall, J M, & Sons, Brazil, Ind.
Rust Engrg Co, Pittsburgh, Pa.
Stearns-Roger Mfg Co, Denver, Colo.
Weber Chimney Co, 332 S Michigan Ave, Chicago, Ill.

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California Steel Prod Co, Barrett & A Sts, Richmond, Calif.
C & C Corp, 379 4th Ave, New York, N. Y.
Condenser Service & Engineering Co, 310 12th St, Hoboken, N. J.
General Machy Co, Riverside Ave, Spokane, Wash.

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Weber Engine Co, 12th & Winchester Sts, Kansas City, Mo.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
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RHEOSTATS

Allen-Bradley Co, Milwaukee, Wis.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Biddle, James G, Co, 1211-13 Arch St, Philadelphia, Pa.
Adv page 142
Clark Controller Co, 1146 E 152nd St, Cleveland, Ohio
Cooley Electric Mfg Corp, 217 S Senhte, Indianapolis, Ind.
Cutler-Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Hanson-Van Winkle-Munning Co, Matawan, N. J.
Monitor Controller Co, Lombard & Gay Sts, Baltimore, Md.
Ward Leonard Electric Co, 31 South St, Mt Vernon, N. Y.
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RINGS, CHILL

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Cook, C Lee, Mfg Co, 916 S 8th St, Louisville, Ky.
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Adv pages 276, 277
American Manganese Steel Div, 397 E 14th St, Chicago Heights, Ill.
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Chase Brass & Copper Co, Inc, 236 Grand St, Waterbury, Conn.
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General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
General Welding & Equipment Co, 268 Northampton St, Boston, Mass.
Harnischfeger Corp, Milwaukee, Wis.
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Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio
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Adv pages 156, 157
Scovill Mfg Co, 99 Mill St, Waterbury, Conn.
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Stoody Co, Whittier, Calif.
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Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
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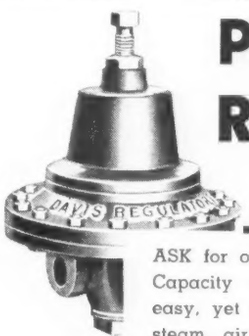
Youngstown Sheet & Tube Co, Youngstown, Ohio
Adv page 176

ROPE, WIRE

American Cable Div, American Chain & Cable Co, Wilkes-Barre, Pa.



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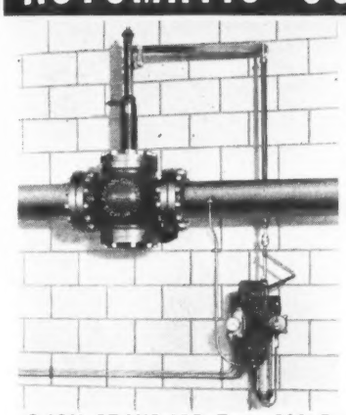

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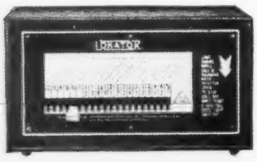

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Adv pages 4-5
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National Valve & Mfg Co, 3102 Liberty Ave, Pittsburgh Pa.
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Laminated Shim Co, 61 Union St, Glenbrook, Conn.
Adv page 144
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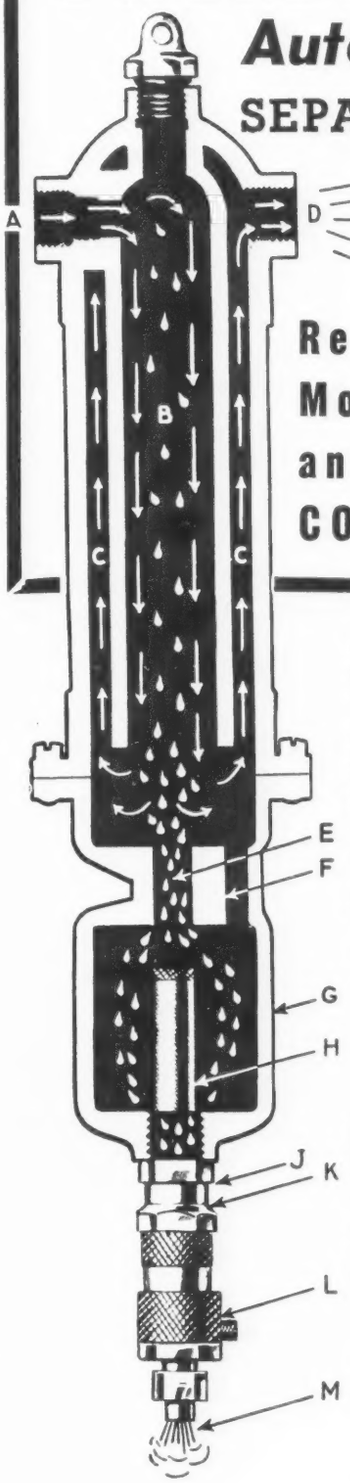

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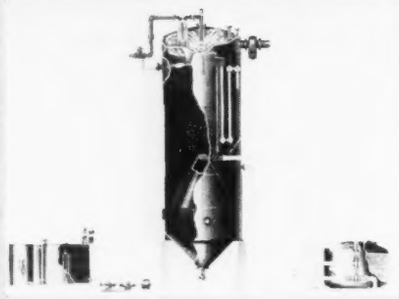

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Adv page 255
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Adv pages 212, 218, 238, 246
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Adv page 109
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
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(See Blowers, Soot)

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(See Tachometers)

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(See Gear Units, Power-Transmission)

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Adv page 141
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Adv pages 38, 39
Connery Construction Co, 2nd & Luzerne Sts, Phila, Pa.
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Erie City Iron Works, 1422 East Ave, Erie, Pa.
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Adv page 185
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(See Conveyors, Pneumatic, Steam-Jet)

STOKERS, CHAIN-, TRAVELING-GRATE

Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Illinois Stoker Co, Alton, Ill.
Johnston & Jennings Co, 878 Addison Rd, Cleveland, Ohio
(*Stowe compensating-feed stoker*)
Adv page 131
Laclede Stoker Co, 4440 Hunt Ave, St Louis, Mo.
McClave Co, 751 Mill St, Allentown, Pa.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Stearns-Roger Mfg Co, Denver, Colo.

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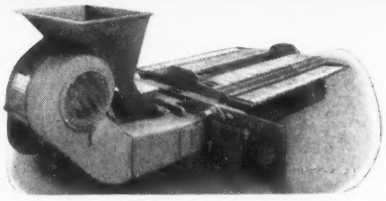
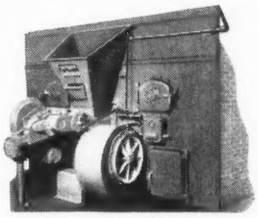


• DETROIT LOSTOKER •

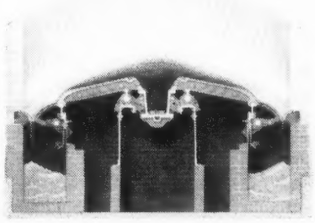
Smaller type of plunger feed Stoker. For various cast iron, steel firebox, tubular, or small water tube boilers.



• DETROIT UNISTOKER •

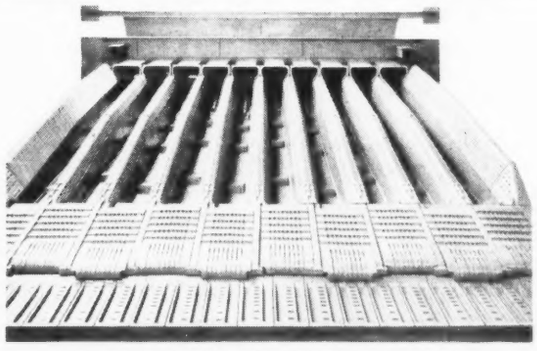
(With Detroit Adjustable Feed)

Single Retort, mechanically driven, unit type, operated by either electric motor or turbine. For 125 to 300 Horsepower boilers.



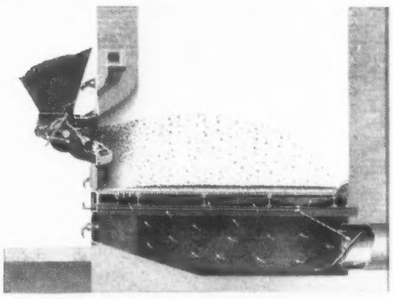
• DETROIT C-D STOKER •

Single Retort with alternate moving, and stationary air cooled grates. Adjustable continuous discharge of ashes. From 300 Horsepower boilers and upwards.



• DETROIT MULTIPLE RETORT STOKER •

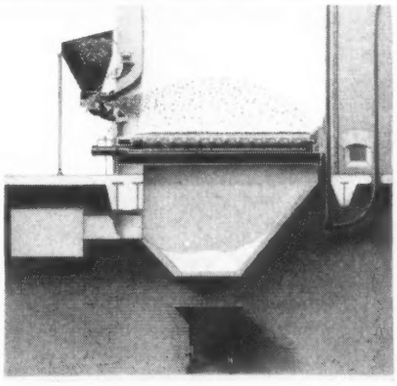
For large power boilers. Inclined Retorts with adjustable moving bottom plates, extension grates, dumping or continuous ash discharge.



• DETROIT ROTOSTOKER •

(Stationary Grate Type)

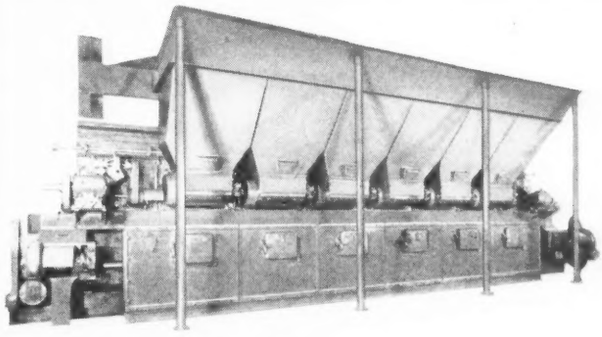
Spreader Stoker. Burns fine coal in suspension, coarser coal or refuse on the grates. Over-Throw Rotors insure uniform fuel distribution. For medium boilers.



• DETROIT ROTOSTOKER •

(Power or Hand Dumping Type)

Over-Throw Rotors and even distribution. Discharges the ash into the pit or basement below. For medium or large power boilers.



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STOKERS, OVERFEED

American Coal Burner Co, 155 E Superior St, Chicago, Ill.
Canton Stoker Corp, 741 Andrew Place, Canton, O.
Adv page 241
Combustion Engrg Co, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Detroit Stoker Co, General Motors Bldg, Detroit, Mich.
Adv page 239
Flynn & Emrich Co, 301 Holliday St, Baltimore, Md.
Hoffman Combustion Engrg Co, 709 Marquette Bldg, Detroit, Mich.
Johnston & Jennings Co, 878 Addison Rd, Cleveland, Ohio.
Adv page 131
McClave Co, 751 Mill St, Allentown, Pa.
Perfection Grate & Stoker Co, Springfield, Mass.
Whiting Stoker Co, 4711 W North Ave, Chicago, Ill.

STOKERS, SPREADER

American Coal Burner Co, 155 E Superior St, Chicago, Ill.
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Combustion Engrg Co, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Detroit Stoker Co, General Motors Bldg, Detroit, Mich.
Adv page 239
Hoffman Combustion Engrg Co, Marquette Bldg, Detroit, Mich.
Iron Fireman Mfg Co, 3295 W 106th St, Cleveland, Ohio
McClave Co, 751 Mill St, Allentown, Pa.
Whiting Stoker Co, 4711 W North Ave, Chicago, Ill.

STOKERS, UNDERFEED, MULTIPLE-RETORT

American Engrg Co, Aramingo Ave, Philadelphia, Pa.
Adv pages 16, 17
Clizbe Bros Mfg Co, Plymouth, Ind.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Detroit Stoker Co, General Motors Bldg, Detroit, Mich.
Adv page 239
Hoffman Combustion Engrg Co, Marquette Bldg, Detroit, Mich.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

STOKERS, UNDERFEED, SINGLE-, DOUBLE-RETORT

Bros, Wm, Boiler & Mfg Co, Nicollet I, Minneapolis, Minn.
Brownell Co, 301 N Findlay St, Dayton, Ohio
Canton Stoker Corp, 741 Andrew Place, Canton, Ohio
Adv page 241
Clizbe Bros Mfg Co, Plymouth, Ind.
Combustioneer Div, Steel Prod Engrg Corp, Springfield, Ohio.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Conco Engrg Works, Mendota, Ill.
Detroit Stoker Co, General Motors Bldg, Detroit, Mich.
Adv page 239
Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.
Adv page 147
Flynn & Emrich Co, 301 Holliday St, Baltimore, Md.
Frederick Iron & Steel Co, Frederick, Md.
Adv page 142
General Machinery Co, Riverside Ave, Spokane, Wash.
Hoffman Combustion Engrg Co, Marquette Bldg, Detroit, Mich.
Iron Fireman Mfg Co, 3295 W 106th St, Cleveland, Ohio
Leffel, James & Co, Springfield, Ohio
Link-Belt Co, 2410 W 18th St, Chicago, Ill.
Adv page 3
McClave Co, 751 Mill St, Allentown, Pa.
Meyer Furnace Co, Peoria, Pa.
Perfection Grate & Stoker Co, Springfield, Mass.
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
U. S. Machine Corp, Lebanon, Ind.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

STORAGE SYSTEMS, COAL

Bartlett & Snow, C O, Co, Cleveland, Ohio
Brady Conveyors Corp, 20 W Jackson Blvd, Chicago, Ill.
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Chain Belt Co, 1674 W Bruce St, Milwaukee, Wis.
Fairfield Engrg Co, 305 Barnhart St, Marion, Ohio
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Hahn Engrg Div, 233 Broadway, New York, N. Y.
Adv page 194
Jeffrey Mfg Co, 932-99 N 4th St, Columbus, Ohio
Lidgerwood Mfg Co, Elizabeth, N. J.
Link-Belt Co, 300 W Pershing Rd, Chicago, Ill.
Adv page 3
Sauerman Bros, Inc, 462 S Clinton St, Chicago, Ill.
Savage, W J, Co, Knoxville, Tenn.
Stearns-Roger Mfg Co, Denver, Colo.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47

STRAINERS, GAS, AIR

Alco Valve Co, 2628 Big Bend Blvd, St Louis, Mo.
Andale Co, 1600 Arch, Phila, Pa.
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Burgess Battery Co, 500 W Huron St, Chicago, Ill.
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Cash Universal Regulator Co, Marshalltown, Iowa.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Cuno Engrg Corp, Meriden, Conn.
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Detroit Lubricator Co, 5900 Trumbull Ave, Detroit, Mich.
Eddington Metal Specialty Co, Box K, Eddington, Pa.
Adv pages 221, 228
Edward Valve & Mfg Co, 1150 W 145th St, East Chicago, Ind.
Electric Valve Mfg Co, 67 Murray St, New York, N. Y.
Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
General Controls Co, 810 Allen Ave, Glendale, Calif.
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kraissl Co, Hackensack, N. J.
Leslie Co, Lyndhurst, N. J.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mueller Co, Decatur, Ill.
Sarco Co, Inc, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Staples & Pfeiffer, Ltd, San Francisco, Calif.
Staynew Filter Corp, Rochester, N. Y.
Tryco Products Inc, 1 Railroad Ave, Westfield, Mass.
Wright-Austin Co, Detroit, Mich.

STRAINERS, OIL

Andale Co, 1600 Arch, Phila, Pa.
Anderson, V D, 1934 W 96th St, Cleveland, Ohio
Anthony Co, 47-33 5th St, Long Island City, N. Y.
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Bowser, S F, & Co, 1302 E Creighton, Fort Wayne, Ind.
Buffalo Meter Co, 2887 Main St, Buffalo, N. Y.
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Cash Universal Regulator Co, Marshalltown, Iowa.
Chicago Flexible Shaft Co, Roosevelt Rd, Chicago, Ill.
Coen Co, 40 Boardman Place, San Francisco, Calif.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Electric Valve Mfg Co, 67 Murray St, New York, N. Y.
Elliott Co, Jeannette, Pa.
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Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa.
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
Foster Pump Works Inc, 50 Washington St, Brooklyn, N. Y.
Gaso Pump & Burner Mfg Co, Tulsa, Okla.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kieley & Mueller Inc, 40 W 13th St, New York, N. Y.
Kinney Mfg Co, 3529 Washington St, Boston, Mass.
Kraissl Co, Hackensack, N. J.
Leahy Mfg Co, Los Angeles, Cal.
Leslie Co, Lyndhurst, N. J.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Mahr Mfg Co, Minneapolis, Minn.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
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Monarch Mfg Works, 2731 E Westmoreland St, Phila, Pa.
Morrison Bros Co, Dubuque, Iowa
Mueller Co, Decatur, Ill.
National Airoil Burner Co, 1284 E Sedgley Ave, Phila, Pa.
Newark Wire Cloth Co, 355-369 Verona Ave, Newark, N. J.
Nugent, Wm W, & Co, 402 N Hermitage Ave, Chicago, Ill.
Preferred Utilities Mfg Corp, New York, N. Y.
Sarco Co, Inc, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Spence Engrg Co, Inc, 61 Grant St, Walden, N. Y.
Staples & Pfeiffer Ltd, 528 Bryant St, San Francisco, Calif.
Staynew Filter Corp, Rochester, N. Y.
Wright-Austin Co, Detroit Mich.

STRAINERS, STEAM

American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
Adv page 134
Andale Co, 1600 Arch St, Philadelphia, Pa.
Anderson, V D, Co, 1934 W 96th St, Cleveland, Ohio
Atwood & Morrill Co, Salem, Mass.
Carling Turbine Blower Co, 25 St. John's Rd, Worcester, Mass.
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Cash Universal Regulator Co, Marshalltown, Iowa
Cashin, W D, Co, 69 A St, Boston, Mass.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Eddington Metal Specialty Co, Box K, Eddington, Pa.
Adv pages 221, 228
Edward Valve & Mfg Co, 1150 W 145th St, E Chicago, Ind.
Electric Valve Mfg Co, 67 Murray St, New York, N. Y.
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Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
General Controls, 810 Allen Ave, Glendale, Calif.
Goyne Steam Pump Co, Ashland, Pa.
Illinois Engrg Co, Racine Ave & 21st St, Chicago, Ill.
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kieley & Mueller Inc, 40 W 13th St, New York, N. Y.
Leahy Mfg Co, Los Angeles, Cal.
Leslie Co, Lyndhurst, N. J.
McAlear Mfg Co, Chicago, Ill.
Adv page 233
Marsh, Jas P, Corp, 2049 Southport Ave, Chicago, Ill.
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mueller Co, Decatur, Ill.
Newark Wire Cloth Co, 355-369 Verona Ave, Newark, N. J.
Sarco Co, Inc, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Spence Engrg Co, Inc, 61 Grant St, Walden, N. Y.
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Sterling Inc, Milwaukee, Wis.
Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland, Ohio
Tryco Products, Inc., 1 Railroad Ave, Westfield, Mass.
Webster, Warren, & Co, Camden, N. J.
Adv page 247
Wright-Austin Co, Detroit, Mich.

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American District Steam Co, 70 Bryant St, N Tonawanda, N. Y.
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Barrett, Haentjens & Co, Hazleton, Pa.
Blackmer Pump Co, 2200 Century Ave, Grand Rapids, Mich.
Buffalo Meter Co, 2887 Main St, Buffalo, N. Y.
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Cash Universal Regulator Co, Marshalltown, Iowa.
Cashin, W D, Co, 69 A St, Boston, Mass.
Cuno Engrg Corp, Meriden, Conn.
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
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Detroit Lubricator Co, 5900 Trumbull Ave, Detroit, Mich.
Eddington Metal Specialty Co, Box K, Eddington, Pa.
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Electric Valve Mfg Co, 67 Murray St, New York, N. Y.
Elliott Co, Jeannette, Pa.
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Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
Foster Pump Works, Inc, 50 Washington St, Brooklyn, N. Y.
General Controls Co, 810 Allen Ave, Glendale, Calif.
Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
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Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
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McDonnell & Miller, Wrigley Bldg, Chicago, Ill.
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Monarch Mfg Works, 2731 E Westmoreland St, Phila, Pa.
Newark Wire Cloth Co, 355-369 Verona Ave, Newark, N. J.
Sarco Co, Inc, 475 5th Ave, New York, N. Y.
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Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Spence Engrg Co Inc, 61 Grant St, Walden, N. Y.
Spray Engrg Co, 111 Central St, Somerville, Mass.
Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Calif.
Staynew Filter Corp, Rochester, N. Y.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Watson-Stillman Co, Roselle, N. J.
Adv page 207
Wright-Austin Co, Detroit, Mich.
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Adv pages 103, 217, 222, 252, 254d

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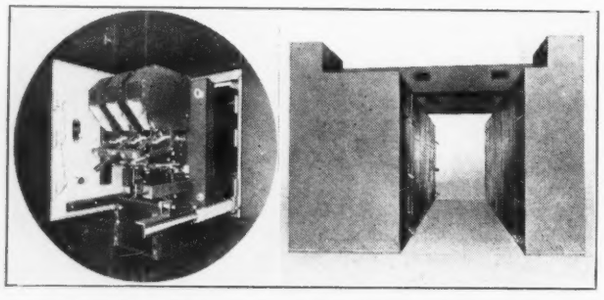

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Adv pages 14, 15, 44, 45, 145
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Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

SUPERHEATERS

Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bros, Wm, Boiler & Mfg Co, Nicollet Id, Minneapolis, Minn.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Edge Moor Iron Works, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kan.
Adv page 119
Riley Stoker Corp, 999 Neponset St, Worcester, Mass.
Adv pages 90, 91
Union Iron Works, Erie, Pa.

SWITCHBOARDS

Allen-Bradley, Milwaukee, Wis.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Bardco Mfg & Sales Co, 4031 Goodwin Ave, Los Angeles, Calif.
Bogue Electric Co, 80 Glover Ave, Paterson, N. J.
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Climax Engrg Co, Clinton, Iowa
Continental Diamond Fibre Co, Newark, Del.
Cutler-Hammer Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Hanson-Van Winkle - Munning Co, Matewan, N. J.
I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Phila, Pa.
Metropolitan Electric Mfg Co, 22-48 Steinway, Long Island City, N. Y.
Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
Adv page 242
Square D Co, Rivard & Piquette Sts, Detroit, Mich.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

SWITCHES, ELECTRIC

(See Also, Breakers, Circuit)
Allen-Bradley Co, Milwaukee, Wis.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
Arrow-Hart & Hegeman Elect Co, 105 Hawthorn, Hartford, Conn.
Automatic Switch Co, 41 E 11th St, New York, N. Y.
Bryant Electric Co, Bridgeport, Conn.
Clark Controller Co, 1146 E 152nd St, Cleveland, Ohio
Colt's Patent Fire Arms Mfg Co, Hartford, Conn.
Cutler-Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
Adv page 101
Delta-Star Electric Co, Fulton St, Chicago, Ill.
G & W Electric Specialty Co, 7780 Dante Ave, Chicago, Ill.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Phila, Pa.
Jefferson Electric Co, Bellwood, Ill.
McDonnell & Miller, Wrigley Bldg, Chicago, Ill.
Metropolitan Electric Mfg Co, 22-48 Steinway, Long Island City, N. Y.
Monitor Controller Co, Baltimore, Md.
Pacific Electric Mfg Corp, 5815 3rd St, San Francisco, Calif.
Penn Electric Switch Co, Goshen, Ind.
Railway & Industrial Engrg Co, Greensburg, Pa.
Roller-Smith Co, 1766 West Market St, Bethlehem, Pa.
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Schweitzer & Conrad, 4433 Ravenswood, Chicago, Ill.
Southern States Equipment Corp, Birmingham, Ala.
Square D Co, Rivard & Piquette Sts, Detroit, Mich.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
Zenith Electric Co, 845 S Wabash Ave, Chicago, Ill.

SYNCHRONIZERS AUTOMATIC

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Adv page 11, 19, 37, 43
Bardco Mfg & Sales Co, 4031 Goodwin Ave, Los Angeles, Cal.
Burlington Instrument Corp, 316 Valley St, Burlington, Iowa
Electric Machinery Mfg Co, 1331 Tyler St, N E, Minneapolis, Minn.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
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SYNCHROSCOPES

Burlington Instrument Corp, 316 Valley St, Burlington, Ia.
General Electric Co, Schenectady, N. Y.
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Roller-Smith Co, 1766 W Market St, Bethlehem, Pa.
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Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
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Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
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TACHOMETERS

Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
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Biddle, James G, Co, 1211-13 Arch St, Philadelphia, Pa.
Adv page 142
Bristol Co, Waterbury, Conn.
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
Coats Machine Tool Co, 17 Tudor Lane, Scarsdale, N. Y.
Durant Mfg Co, 1954 N Buffum St, Milwaukee, Wis.
Esterline-Angus Co, Box 596, Indianapolis, Ind.
Foxboro Co, 38 Neponset Ave, Foxboro, Mass.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
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Scherr, George, Co, 126 Lafayette St, New York, N. Y.
Stewart-Warner Corp, 1826 W Diversey Pkwy, Chicago, Ill.
Veeder-Root, Inc, Hartford, Conn.
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Adv pages 181, 243
Zernickow, O, Co, 21 Park Row, New York, N. Y.

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Hahn Engrg Div, 233 Broadway, New York, N. Y.
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Meehanite Corp, Dept A, 311 Ross St, Pittsburgh, Pa.
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United Conveyor Corp, 37 W Van Buren St, Chicago, Ill.
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York Ice Machy Corp, York, Pa.

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Adv page 172
Alpha Tank & Sheet Metal Mfg Co, 5005 S 38th St, St Louis, Mo.
American Welding Co, 30 Church St, New York, N. Y.
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bass Foundry & Machine Co, Fort Wayne, Ind.
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Chicago Bridge & Iron Co, 2454 McCormick Bldg, Chicago, Ill.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Colonial Iron Works Co, 17643 St. Clair Ave, Cleveland, O.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Connery Construction Co, 2nd & Luzerne Sts, Phila, Pa.
Adv page 184
Edge Moor Iron Works, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Farrar & Trefts, Buffalo, N. Y.
Frick Co, Inc, 325 Broadway, Waynesboro, Pa.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Graver Tank & Mfg Co, Inc, East Chicago, Ill.
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Kirk & Blum Mfg Co, 2831 Spring Grove Ave, Cincinnati, O.
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Leader Iron Works, Inc, Decatur, Ill.
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Long, Walter, Mfg Co, Pittsburgh, Pa.
Marshall Heater Co, Dayton, Ohio
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Union Iron Works, Erie, Pa.
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Wickes Boiler Co, 515 N Washington Ave, Saginaw, Mich.
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General Electric Co, Schenectady, N. Y.
Adv page 14, 15, 44, 45, 145
Leeds & Northrup Co, 4970 Stenton Ave, Philadelphia, Pa.
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Natural Gas Equipment, Inc, 539 Petroleum Bldg, Los Angeles, Calif.
Wheelco Instruments Co, 1923 S Halstead, Chicago, Ill.
Adv page 243

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Adv page 209

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Bailey Meter Co, 1036 Ivanhoe Rd, Cleveland, Ohio
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Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
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Defender Automatic Regulator Co, St Louis, Mo.
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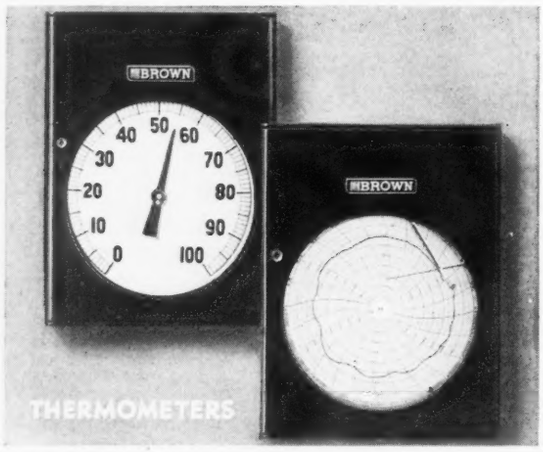

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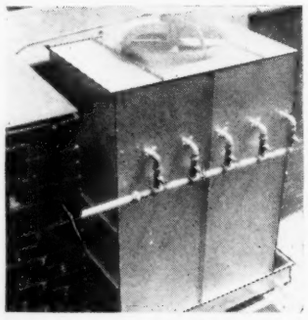

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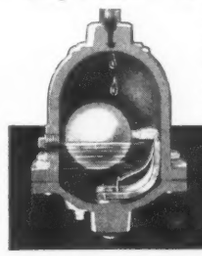

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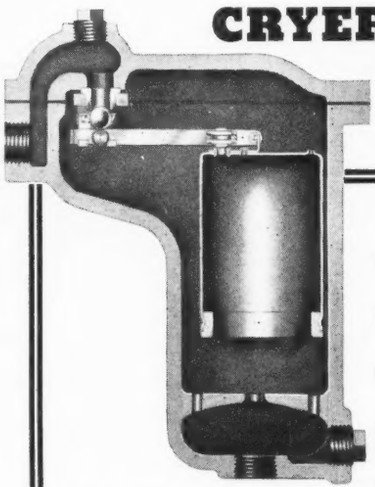

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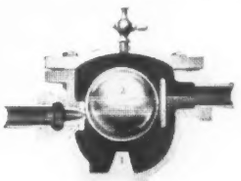

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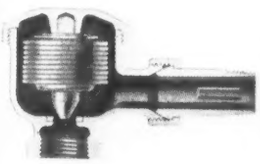

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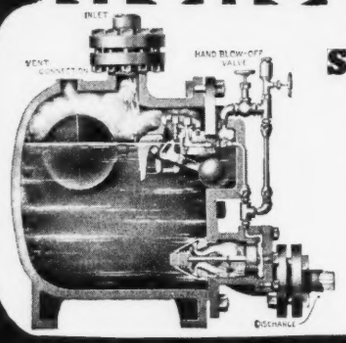

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A positive, instantaneous, high pressure trap which occupies smaller space yet has greater capacity than any others available. The discharge valve is non-wire-drawing type, being entirely open or closed at all times. All valves, seats and working parts are of stainless steel for long trouble-free operation . . . for Super-Pressures and Super-Heat in the Super-Power Plant.

Write for Operating Details.

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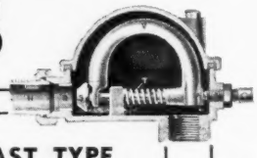

MEDIUM PRESSURE AND BLAST TYPE
STEAM TRAPS

For discharging both air and water condensate from single pieces of apparatus — this Haines Trap is ideally suited for many industrial and commercial uses including Steam Presses, Air Conditioning Apparatus, Hospital Equipment, Kitchen Equipment, Laundries, and Textile Dryers.

The Haines No. 03 Series Trap is ruggedly constructed with a cast iron bolted case. As with all Haines Traps this cover may be removed, exposing all parts, for examination, under pressure at any time. Cover is provided with a test plug and adjustment screw on outside of case. Careful adjustment is made during inspection at the factory but adjustment can be made in the field to meet plant requirements.

Haines Traps are simple in operation. Placed on end of a pipe-line, valve is wide open until steam enters trap. Heat expands the semi-circular, hermetically sealed tube containing a highly sensitive volatile fluid. Steam heat expands tube and closes trap. Changes of only one degree temperature operate valve.

Haines No. 08 Series Traps are made in three types: No. 1 Pressures to 20 lbs., No. 2 Blast Type—Pressures 20 to 60 lbs.; No. 3 Pressures 60 to 100 lbs.

All Haines No. 08 Trap types are available in five sizes ½" to 1½".

The well-known Haines "Vento" Radiator Type Trap is also available in sizes ½" to 1".

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STEAM HEATING EQUIPMENT
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Marsh, Jas P, Corp, 2049 Southport Ave, Chicago, Ill.
Milwaukee Valve Co, Milwaukee, Wis.
Monash-Younker Co, 1315 W Congress St, Chicago, Ill.
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Plouff Co, 1150 Columbus Ave, Boston, Mass.
Reading-Pratt & Cady Div, Reading, Pa.
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Sarco Co, 475 5th Ave, New York, N. Y.
Adv pages 35, 36
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Sterling Inc, Milwaukee, Wis.
Stickle Steam Specialties Co, 2217 Valley Ave, Indianapolis, Ind.
Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland, O.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
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Trane Co, 2012 Cameron Ave, La Crosse, Wis.

TRAPS, STEAM

American District Steam Co, 70 Bryant St, N Tonawanda, N.Y.
Adv page 134
Anderson, V D, Co, 1934 W 96th St, Cleveland, Ohio
Armstrong Machine Works, 812 Maple St, Three Rivers, Mich.
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Atwood & Morrill Co, Salem, Mass.
Barnes & Jones Inc, 128 Brookside Ave, Jamaica Plain, Mass.
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Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
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Coe Mfg Co, Painesville, Ohio
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Cryer Trap & Valve Co, 366 Madison Ave, New York, N. Y.
Adv page 245
Davis Engrg Corp, 1064-16 E Grand St, Elizabeth, N. J.
Adv pages 235, 240, 252
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Dunham, C A, Co, 450 E Ohio St, Chicago, Ill.
Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
Haines, Wm S, Co, 12th & Buttonwood Sts, Philadelphia, Pa.
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Hoffman Specialty Co, Inc, 1001 York St, Indianapolis, Ind.
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Johnson Corp, 865 Wood St, Three Rivers, Mich.
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Milwaukee Valve Co, Milwaukee, Wis.
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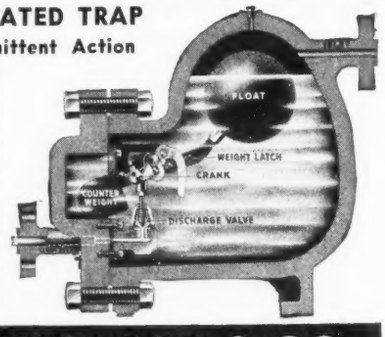
Adv pages 206, 246, 248

NICHOLSON

WEIGHT-OPERATED TRAP
Automatic Intermittent Action

Designed and built to meet all the requirements of a trap for modern high pressure power plants and refineries. Model C is especially recommended for draining Headers, Line Purifiers, Separators, Superheated Drains, Turbine Throttle Valve Drips, Pressure Reducing Valves, etc. Large capacity, positive action. Handles pressures up to 1500 lbs. at 1000° max. temperature.



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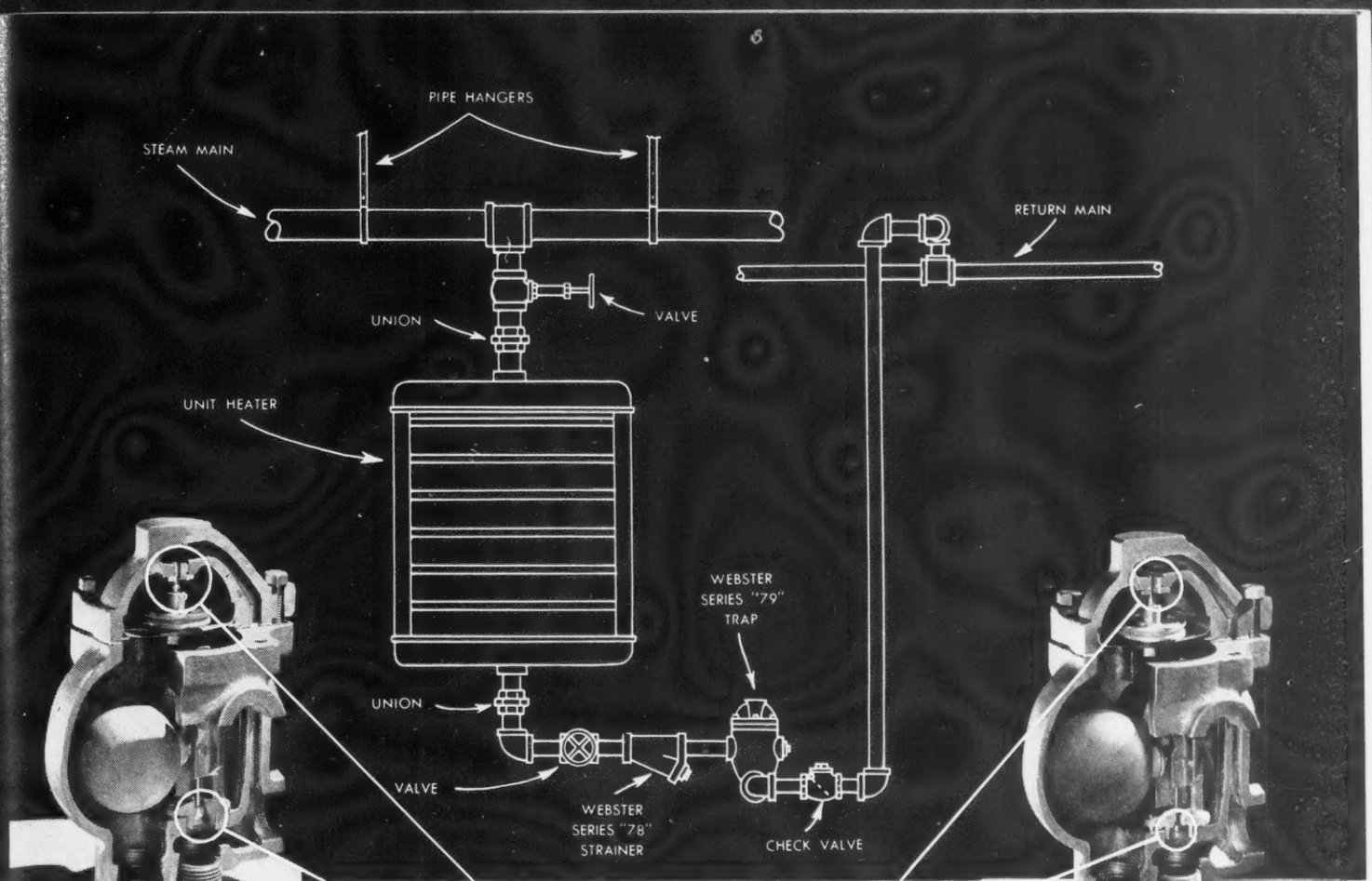

Series "26" Trap for pressures up to 15 lbs. per square inch.

Full-sized Thermostatic Air Bypass. Fully compensated for operation at all pressures.

Outward-Opening Valve keeps water moving continuously. No water-logging under excess pressures.

Series "79" Trap for pressures up to 150 lbs. per square inch.

–ideal for Unit Heaters

There is nothing intermittent in the operation of Webster Combination Float and Thermostatic Traps. . . They provide *continuous draining*. The float-controlled *outward opening valve* stays open as long as there is water present. Stepping up the pressure results in quicker heating up.

Then, consider overload capacity. When you have steam coming into a cold unit heater with a fan blasting cold air across it, the trap must handle a tremendous volume of condensation for a short time. Under this condition the generous thermostatic bypass of the Webster Combination Float and Thermostatic Trap plays an extra part . . . handling a substantial volume of condensation and only closing when the trap body is finally filled with saturated steam.

Air binding of unit heaters is unknown with Webster Combination Float and Thermostatic Traps. The full-sized thermostatic bypass insures continuous and immediate discharge of all the air and non-condensible gases that pass into the trap. The thermostatic element is no snap-action after-thought. It has the same capacity as the famous standard ½" Webster Thermostatic Trap.

There are a score of other advantages . . . You will find them covered in detail in our catalog. But, try one on your next unit heater application. You'll be surprised and pleased. Pretty good deliveries, too—everything considered.

WARREN WEBSTER & COMPANY, CAMDEN, N. J.
Pioneers of the Vacuum System of Steam Heating :: Est. 1888
Representatives in 65 principal Cities : : Darling Bros., Ltd., Montreal, Canada

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Process Steam Traps, Radiator Valves, Thermostatic Traps, Dirt Pockets, Dirt Strainers, Lift Fittings, Expansion Joints, Vacuum Governors, Air Separating Tanks, Concealed (non-ferrous) Radiators, Unit Heaters, Boiler Protectors, Boiler Return Traps, Vent Traps, Vacuum and Vapor Systems of Steam Heating, Central Heat Controls, Heating Modernization Programs.

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Boiler Tube Co of America, 3126 Preble Ave, Pittsburgh, Pa.
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Globe Steel Tubes Co, 4051 W Burnham St, Milwaukee, Wis.
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Jones & Laughlin Steel Co, Pittsburgh, Pa.
National Tube Co, Pittsburgh, Pa.
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Scovill Mfg Co, 99 Mill St, Waterbury, Conn.
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Atlantic Metal Hose Co, 107 W 64th St, New York, N. Y.
Chicago Metal Hose Corp, 1312 S 3rd Ave, Maywood, Ill.
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Federal Metal Hose Corp, 277 Military Rd, Buffalo, N. Y.
Mall Tool Co, 7740 S Chicago Ave, Chicago, Ill.
Mulconroy Co, 54th & Jefferson Sts, Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co, 7202 Powers Lane, Philadelphia, Pa.
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Moore Steam Turbine Div, 37 Coats St, Wellsville, N. Y.
Murray Iron Works Co, Burlington, Iowa
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NICHOLSON

THERMOSTATIC STEAM TRAPS

LARGE CAPACITY—two to six times greater valve area than average.

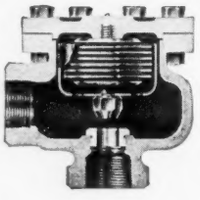
NO AIR BINDING—All types discharge air as efficiently as water.

NO FREEZE-UPS—they drain completely when cold.

NO ADJUSTMENT—use same size valve and seat from vacuum to maximum pressure.

NO DRIBBLING—water-sealed discharge trap wide open when cold—shut upon contact with steam.

FOUR TYPES—cover every industrial trap requirement.



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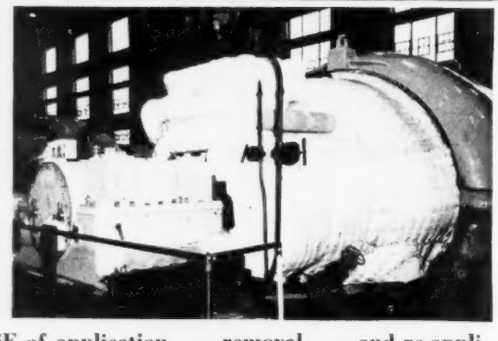
125 Oregon Street Wilkes-Barre, Pennsylvania.

TURBINE BLANKETS



EASE of application . . . removal . . . and re-application, cleanliness, durability, and low thermal conductivity are features that have made UNARCO enclosed pad type Turbine Blankets outstanding favorites with engineers all over the country. Glass-fabric pad with glass-wool filler, as well as asbestos blankets, now available for high temperature service. Easy to order—we work with all principal turbine builders. Quotations on request.

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UNION ASBESTOS & RUBBER CO.
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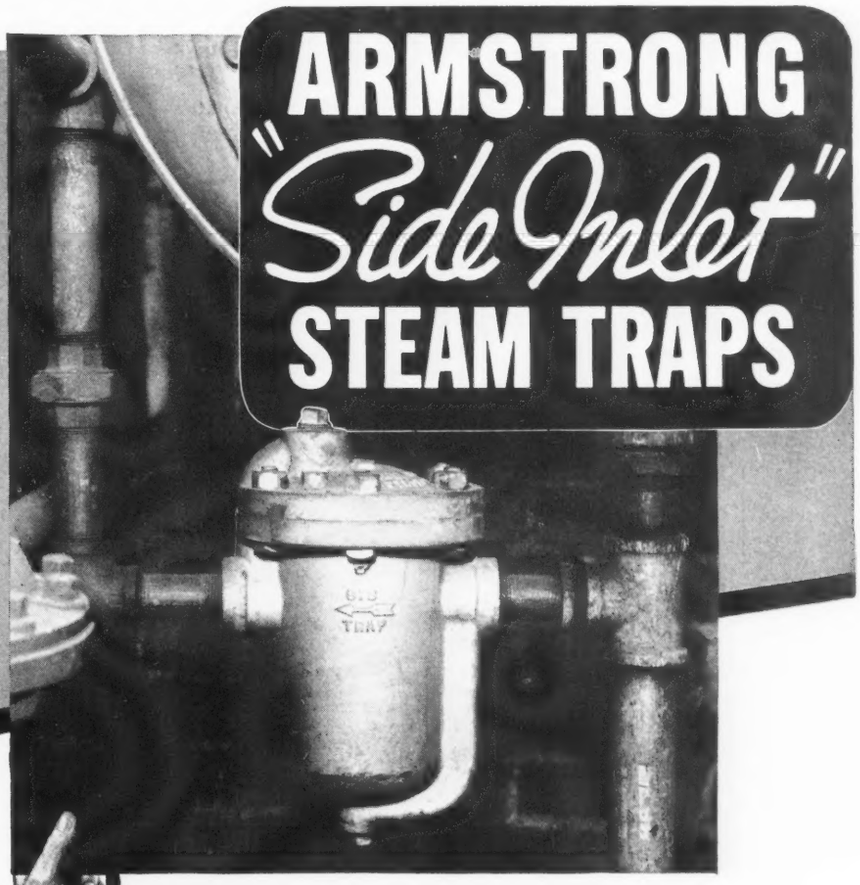
ARMSTRONG "Side Inlet" STEAM TRAPS

Easy to INSTALL! Easy to INSPECT!



EXPERIENCED heating and piping men and plant operating engineers are quick in recognizing the superiority of the design of Armstrong 800 Series traps with "straight-thru" pipe connections. The pipes are connected to the body, NOT TO THE CAP, thus, when you loosen the cap bolts, you have the "whole works" ready to lift out for convenient, easy inspection on your work bench. The body itself stays in the line—no messing with a body full of hot water, no nuisance of breaking and remaking pipe connections.

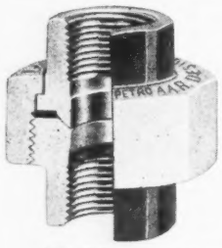
This is the design that Armstrong pioneered more than 10 years ago. Due to the long wearing qualities of Armstrong traps, most users don't have much occasion to notice these "convenience" features, nevertheless, they're there—ANOTHER ONE OF THE "PLUS VALUES" USERS GET IN ARMSTRONG TRAPS! *For catalog, write Armstrong Machine Works, 812 Maple St., Three Rivers, Michigan.*

The Cap Carries the "Whole Works"

ARMSTRONG MACHINE WORKS

FORGED STEEL UNIONS

● A Forged Steel Union for your every need. Select the one best suited to your service.



PETRO

sizes ⅛" to 3"

steel to steel seats

A-A-R Designs

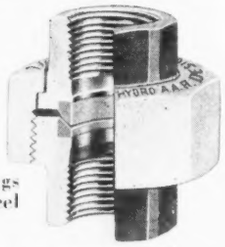
Working pressure, pounds per square inch

	STEAM OR HOT OIL			COLD WATER, OIL OR GAS, NON-SHOCK
Black or Undylited.	500° F	750° F	850° F	2,000 LBS.
	1150 lbs.	830 lbs.	630 lbs.	

HYDRO

sizes ¼" to 3"

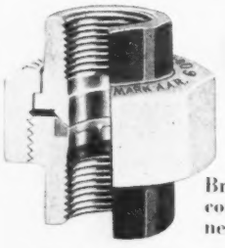
A-A-R Designs



Bronze to bronze seats. Seat rings are completely fused to the steel by a new method of brazing

Working pressure, pounds per square inch

	STEAM OR HOT OIL			COLD WATER, OIL OR GAS, NON-SHOCK
Black or Undylited.	500° F	550° F	600° F	2,000 LBS.
	1150 lbs.	600 lbs.	400 lbs.	



MARK, A.A.R.

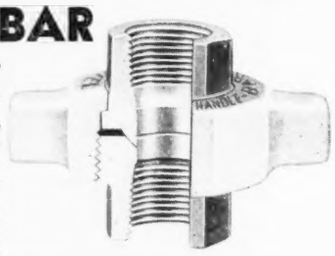
sizes ¼" to 3"

Bronze to steel seat. Seat ring is completely fused to the steel by a new method of brazing.

Working pressure, pounds per square inch

	STEAM OR HOT OIL			COLD WATER, OIL OR GAS, NON-SHOCK
Black or Undylited	500° F	550° F	600° F	2,000 LBS.
	1150 lbs.	600 lbs.	400 lbs.	

HANDLE-BAR



V-thread in nut—⅜" to 1½"
2" to 4" Acme thread in nut
Working Pressure—1150 lbs. at 550° F. or 3000 lbs. Cold.

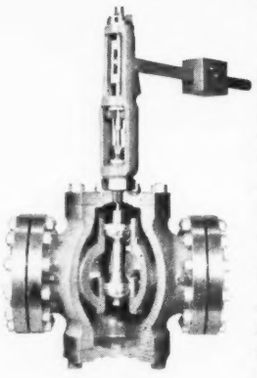
Also manufacturers of Union Check Valves, Water Well Supplies, Electrical Conduit, Mechanical Welded Tubing.

YOUR LOCAL JOBBER CAN SUPPLY YOU

CLAYTON MARK & COMPANY
EVANSTON, ILL.

Originators and Pioneers of Steel Unions Since 1912

CASH STANDARD Series 42
BALANCED LEVER VALVES



For use with steam, water (hot or cold), air, oil, ammonia, various gases.

Handling hot or cold liquids or gases, they control inflow or outflow—to open or closed tanks, feed water heaters, pumps, boilers, purifiers, accumulators, stills, fractionating towers, etc.

They maintain constant valve inlet pressure and outlet pressure, a constant differential pressure, constant liquid levels, or regulate rate of flow.

Operated by automatic controllers, floats, solenoids, thermostats, hydraulic pistons, pneumatic pistons, cables, and other devices.

Manufactured under highest standards

Accurate machining insures perfect alignment—roller guides kill side strains and save packing—easy lever adjustment—large capacity—walls very thick and uniform—both cast Pivot Link and Steel Lever carried on large diameter Nitralloy pins—both double and single seat types shut dead tight on test before shipment—any valve lever movement gives you instant positive inner valve movement without play or lost motion. All standard metals and trims; sizes ½" to 12". Write for Bulletin No. 965.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

When in need of

REGULATING VALVES

Always specify **ATLAS**

See listings in this issue of Power.

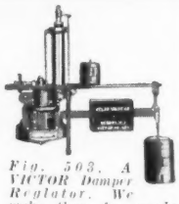


Fig. 503. A VICTOR Damper Regulator. We make them for nearly all pressures and services.

The Atlas Valve Company has been making Regulating Valves *exclusively* for nearly a half century. *"Regulating Valves for Every Service"* is the Atlas slogan.

Fig. 230. This ATLAS Lever Operated Control Valve is "going places." Are you acquainted with it?

Make it a habit to put your regulating problems up to ATLAS, always. In other words, Standardize on Atlas Regulating Valves.

Check the list of principal Atlas products below, write your name, firm, and address on the margin, tear out with this ad., include any special facts we may need, mail, and you will hear from us promptly.

If you are not acquainted with the CAMPBELL regulator shown at the right ask for folder "17 Reasons Why".

Fig. 700. The CAMPBELL Feed Water Regulator.

Fig. 701. This valve controls the Regulator The CAMPBELL has no floats, thermostats, generators, or moving parts.

Ask for facts.

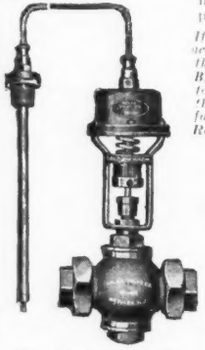


Fig. 650. One of the designs of VICTOR Temperate Regulators

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
289 South St., Newark, N. J.
Representatives in Principal Cities

Please send information on the following Atlas products without obligating me in any way:—

- ☐ Temperature Regulators
- ☐ Float Valves
- ☐ Campbell Boiler Feed Water Regulator
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Leahy Mfg Co, E 8th St, Los Angeles, Calif.
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, O.
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Madden, P E, & Co, Chicago, Ill.
Malleable Iron Fittings Co, Branford, Conn.
Pittsburgh Valve & Fittings Corp, Barberton, Ohio
Rhode Island Fittings Co, Hillsgrove, R. I.
Rhode Island Malleable Iron Works, Hillsgrove, R. I.
Rockwood Sprinkler Co, 54 Harlow St, Worcester, Mass.
Sherman, H B, Mfg Co, Battle Creek, Mich.
United Superior Union Co, 29 Ryerson St, Brooklyn, N. Y.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
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Walworth Co, 60 E 42nd St, New York, N. Y.
Adv page 158, 159

USED EQUIPMENT

(See Searchlight Section of this issue, page 281, and Classified Directory, page 268, December POWER)

VACUUM-CLEANING SYSTEMS

(See Cleaning Systems, Vacuum)

VALVE OPERATORS, HAND-CHAIN

Babbitt Steam Specialties Co, 55 S Water St, New Bedford, Mass.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Cutler-Hammer Inc, 315 N 12th St, Milwaukee, Wis.
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General Electric Co, Schenectady, N. Y.
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Jenkins Bros, 80 White St, New York, N. Y.
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Minneapolis-Honeywell Regulator Co, 2747 4th Ave S, Minneapolis, Minn.
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VALVE-RESEATING MACHINES

Black & Decker Mfg Co, Towson, Md.
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Atlas Valve Co, 289 South St, Newark, N. J.
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Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
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Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
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Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
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Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
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Waters Governor Co, 1123 Oliver Bldg, Boston, Mass.
Watts Regulator Co, Lawrence, Mass.
Watson-Stillman Co, Roselle, N. J.
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Jarecki Mfg Co, Erie, Pa.
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VALVE RESEATING EQUIPMENT
. . . for reconditioning
GATE, GLOBE *and* PUMP VALVES

Dexter Pump Valve Reseating Machine, reseating suction valves in triplex pump.

VALVES SEATED IN POSITION
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MAKES VALVES LAST LONGER
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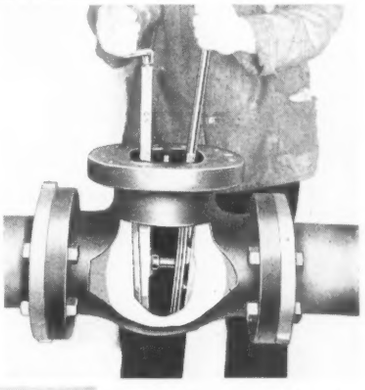
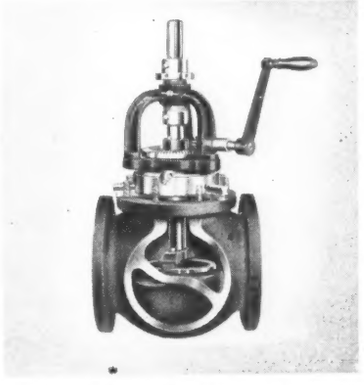
Dexter Pump Valve Reseating Machines are made in capacities from 1½" to 15", for reseating both suction and discharge valve seats. Reseating is accomplished without removing the valve, quickly and easily, making valves absolutely tight to assure the maximum in pump duty. All types of pump valves can be reseated with Dexter Equipment.





Dexter Globe Valve Reseating Machine

Reseating Gate Valve with Dexter Equipment.

Dexter Gate Valve Reseating Machines are made in capacities from 1½" to 48". these machines are self-aligning and maintain correct angle of both seat and disc. Tight closing of reseated valve is assured.

•

Dexter Globe Valve Machines — in capacities from ¼" to 14"—can be used for reseating all types of globe valves and do a perfect, pressure tight job without removing valve from line. In time saving alone Dexter Globe Valve Equipment will pay for itself.

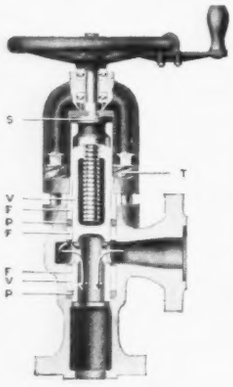
Write for Catalog 40 giving complete details of DEXTER VALVE RESEATING MACHINES.

ALSO Swendeman Automatic SEPARATORS For Compressed Air

The LEAVITT MACHINE CO.
ORANGE, MASS.

YARWAY BLOW-OFF VALVES

Used singly or in tandem in more than 12,000 plants in 67 different industries. Recommended by leading steam plant designers and builders of steam generating equipment.



Seatless Type

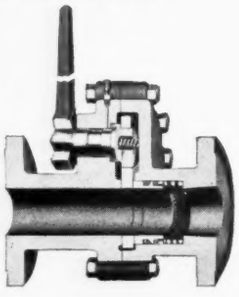
Made in several styles for working pressures up to 1500 lbs. Sizes 1" to 2½". Angle and straightway.

OPERATION: After valve has been closed, shoulder S on plunger V contacts upper follower gland F, forcing it down into body and compressing packing P above and below port, making an absolutely tight valve. Yoke tension springs T maintain continuous compression on packing train. Alemite lubrication of plunger and stem.

Send for celluloid working model and Bulletins B-421 and B-430

Double-Tightening Type

Lever-operated, swing gate design with unique feature of sealing bushing on inlet side, making it double-tightening on both sides of gate. When open provides straight through passage for unobstructed flow. Alemite lubrication of stem and disc. Made in several styles for pressures to 300 lbs. Sizes 1" to 2½". Write for Bulletin B-421.



Tandems

Fig. 1, Yarway Seatless and Double-Tightening Tandem for pressures of 200 to 300 lbs.

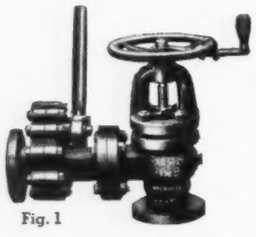


Fig. 1

Fig. 2, Yarway Seatless Type C Tandem for 400 to 600 lbs. pressure. Sizes 1" to 2½".

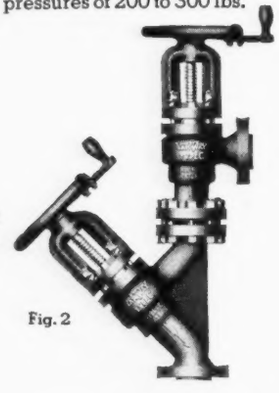


Fig. 2

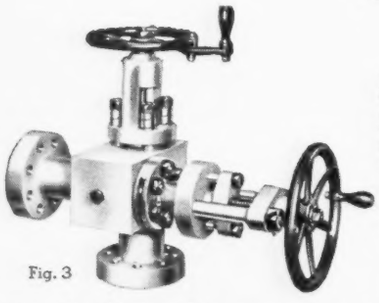


Fig. 3

Fig. 3, Yarway Unit Tandem Valve in which hard seat valve and seatless valve are mounted together in one-piece forged steel body. Sizes 1" to 2", pressures 600 to 2,500 lbs.

Write for Bulletins B-421 and B-430.

See other Yarway Advertisements on pages 103, 217, 222, 254d.

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Adv page 207
Williams, D T, Valve Co, 2854 Spring Grove Ave, Cincinnati, O.
Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.
Adv pages 103, 217, 222, 252, 254d

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Alco Valve Co, St. Louis, Mo.
Barrett, Haentjens & Co, Hazleton, Pa.
Bastian-Blessing Co, 4201 Peterson Ave, Chicago, Ill.
Belfield, H, Co, 435 N Broad St, Phila, Pa.
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Clayton Mark & Co, 1900 Dempster St, Evanston, Ill.
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Bristol Co, Waterbury, Conn.
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McAlear Mfg Co, Chicago, Ill.
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Mason - Neilan Regulator Co, 1186 Adams St, Boston, Mass.
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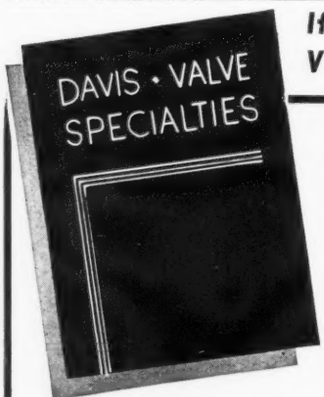

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ALTITUDE Valves . . . Balanced Valves . . . Float Valves . . . Reducing Valves . . . Solenoid Valves . . . and a multitude of other modern types of automatic valves are available in the standard Davis line. Your inquiry will get prompt attention. Catalog on request.

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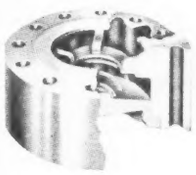
FLANGED SILENT CHECK VALVES



Important and efficient improvement in check valves. Side-guided, free-floating valve, operates in any position—horizontal, vertical or upside down.

Positively silent in operation—corrects water-hammer. Durability insured by proper design—Sizes 1" to 16" Inclusive.

Producers — Pump Governors — Pump Valves — Safety Water Columns — Water Gauges — Gauge Cocks, Feed Water Regulators and Steam Traps.

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Practically as simple in operation as
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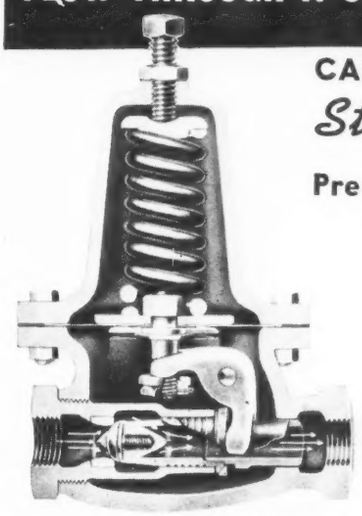

CASH STANDARD
Streamlined
TYPE 1000
Pressure Reducing
VALVE

The Straight Line Flow eliminates turbulence, giving highest valve capacity. From inlet to outlet the fluid flows through this valve in a straight line—a streamline—almost as though there were a pipe running through the valve housing for the fluid to flow through. There is no detour around a dividing wall—the direction of flow is not changed at right angles because of a seat wall—also, the flow is not broken up by valve stems, springs, or other parts.

Because of the Streamlined Flow and No Turbulence, you are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. Supply line pressure may change; demand may change—you still have smooth action, close, dependable regulation. You experience no spoilage results due to erratic pressure—because the reduced pressure never varies. Screwed ends; sizes ¼" x ¼", to 2" x 2½".

You may select a CASH STANDARD Streamlined Valve exactly suited for your service conditions. Bulletin 1000 shows how. Any combination of metals can be obtained for body, trim, valve seat, and seat ring.

Ask About Our 30-Day FREE Trial Offer

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

Type 35-F2

FOSTER FLOAT VALVES

Here is a design (illustrated) of auxillary-operated float valve that will not leak on any working pressure from 10 to 200 lbs. and can be used for water of any temperature up to 212°F. On temperatures above 160°, solid piston is provided in place of cup leather construction shown. The Foster Auxiliary-operated Float Valve is quick, positive and sensitive in operation, as it is actuated primarily by the pressure in the supply line, and, because of this, large cumbersome floats are not required. The specially constructed tied-in type, the Foster Type 35-F2, combines this auxiliary-operated feature with direct action. Can be installed for operation in closed tanks. All types built with either angle or globe bodies.

Type	Service	Working Pressures, Lbs. per Sq. In. Min.	Max.	Maximum Temperature, Deg. Fahr.	Operation	Sizes, In	Connections
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34-F1	For continuous flow service	0	40	212	Direct acting	½-6 1-8	Screwed Flanged
35-F2	For dead-end service and where inlet pressure may drop below 10 lbs. per sq. in.	0	200	212	Combined Auxiliary-operated and Tied-in Type	½-6 1-8	Screwed Flanged

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Plouff Co, 1150 Columbus Ave, Boston, Mass.
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Jenkins Bros, 80 White St, New York, N. Y.
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Kennedy Valve Mfg Co, Elmira, N. Y.
Klingerit, Inc, 16 Hudson St, New York, N. Y.
Adv page 208
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, O.
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Milwaukee Valve Co, Milwaukee, Wis.
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Ohio Brass Co, Manfield, Ohio
Ohio Injector Company, 150 Ohio Ave, Wadsworth, Ohio
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio
Pittsburgh Valve & Fittings Corp, Barberton, Ohio
Plouff Co, 1150 Columbus Ave, Boston, Mass.
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Walworth Co, Inc, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159
Watson-Stillman Co, Roselle, N. J.
Adv page 207
Williams, D T, Valve Co, 2854 Spring Grove Ave, Cincinnati.

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Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Homestead Valve Mfg Co, PO Box 210 Coraopolis, Pa.
Adv page 262
Jenkins Bros, 80 White St, New York, N. Y.
Adv page 110, 111
Kennedy Valve Mfg Co, Elmira, N. Y.
Ludlow Valve Mfg Co, Ft of Adams St, Troy, N. Y.
Adv page 268
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio
Tejax Engineering Corp, 2 Allens Ave, Providence, R. I.
Adv page 216
Walworth Co, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159

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Chapman Valve Mfg Co, Pinevale St, Indian Orchard Mass.
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Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Cutler-Hammer, Inc, 315 N 12th St, Milwaukee, Wis.
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Darling Valve & Mfg Co, Williamsport, Pa.
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Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Edison, Thomas A, Inc, West Orange, N. J.
Edward Valve & Mfg Co, 1150 W 145th St, East Chicago, Ind.
Everlasting Valve Co, 53 Fisk St, Jersey City, N. J.
Foxboro Mfg Co, 38 Neponset Ave, Foxboro, Mass.
General Controls Co, 810 Allen Ave, Glendale, Calif.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Hills-McCanna Co, 3025 N Western Ave, Chicago, Ill.
Homestead Valve Mfg Co, PO Box 210, Coraopolis, Pa.
Adv pages 262
Illinois Engineering Co, Racine Ave & 21st St, Chicago, Ill.
Jenkins Bros, 80 White St, New York, N. Y.
Adv pages 110, 111
Keckley, O C, Co, 400 W Madison St, Chicago, Ill.
Kennedy Valve Mfg Co, Elmira, N. Y.
Ludlow Valve Mfg Co, Ft of Adams St, Troy, N. Y.
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Lunkenheimer Co, PO Box 360, Annex Station, Cincinnati, O.
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Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
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Merco-Norstrom Valve Co, Lexington Ave, Pittsburgh, Pa.
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Minneapolis-Honeywell Regulator Co, 2747 Fourth Ave S, Minneapolis, Minn.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Philadelphia Gear Works, Erie Ave & G St, Phila, Pa.
Adv page 175
Powell, Wm, Co, Cincinnati, Ohio
Adv pages 152, 153
Ruggles-Klingemann Mfg Co, Salem, Mass.
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Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Walworth Co, 60 E 42nd St, New York, N. Y.
Adv pages 158, 159
Webster, Warren, & Co, Camden, N. J.
Adv page 247

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Bordo, L J, Co, Glenside, Pa.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Corning Glass Works, Dept I P, Corning, N. Y.
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Fairbanks Co, 397 Lafayette St, New York, N. Y.
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Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
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Gorton Heating Corp., Cranford, N. J.
Hancock Valve Div, 143 Elias St, Bridgeport, Conn.
Homestead Valve Mfg Co, Box 210, Coraopolis, Pa.
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Jenkins Bros, 80 White St, New York, N. Y.
Adv pages 110, 111
Klingerit, Inc, 16 Hudson St, New York, N. Y.
Adv page 208
Merco-Nordstrom Valve Co, Lexington Ave, Pittsburgh, Pa.
Ohio Injector Co, 150 Ohio Ave, Wadsworth, Ohio
Parker Appliance Co, 17325 Euclid Ave, Cleveland, Ohio
Philadelphia Valve Co, Aramingo Ave, Philadelphia, Pa.
Powell, Wm Co, Cincinnati, O.
Adv pages 152 153
Reading-Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Reed Valve Div, PO Box 2119, Houston, Texas
Taylor Instrument Cos, Rochester, N. Y.
Stockham Pipe Fittings Co, Birmingham, Ala.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Walworth Co, Inc, 60 E. 42nd St, New York, N. Y.
Adv pages 158, 159
Williams, D T, Valve Co, Spring Grove Ave, Cincinnati, O.

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Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Dick, R & J, Co, Inc, Colfax Ave, Passaic, N. J.
Durabla Mfg Co, 114 Liberty St, Room 202, New York, N. Y.
Garlock Packing Co, 400 Main St, Palmyra, N. Y.
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Hill Pump Valve Co, Chicago, Ill.
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Klingerit, Inc, 16 Hudson St, New York, N. Y.
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Klipfel Mfg Co, 2651 W Harrison St, Chicago, Ill.
Linear Packing & Rubber Co., State Rd & Levick St, Phila, Pa.
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, O.
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McAlear Mfg Co, Chicago, Ill.
Adv page 233
Phoenix Specialty Mfg Co, 155 Wooster St, New York, N. Y.
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Watson-Stillman Co, Roselle, N. J.
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Adv page 134
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Cash, A W, Co, 402 N Eldorado St. Decatur, Ill.
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Cash Universal Regulator Co, Marshalltown, Iowa
Chaplin-Fulton Mfg Co, 28-40 Penn Ave, Pittsburgh, Pa.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
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Crane Co, 836 S Michigan Ave, Chicago, Ill.
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Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Defender Automatic Regulator Co, St. Louis, Mo.
Eddington Metal Specialty Co, Box K, Eddington, Pa.
Adv pages 221, 228
Fisher Governor Co, 203 S 1st Ave, Marshalltown, Iowa
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
General Controls Co, 267 5th Ave, New York, N. Y.
General Regulator Corp, 165 Broadway, New York, N. Y.
Golden-Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
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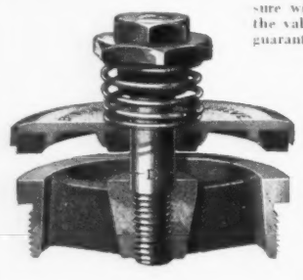
Grove Regulator Co, 1190 67th St, Oakland, Calif.
Hagan Corp, 300 Ross St, Pittsburgh, Pa.
Adv pages 32, 33, 149
Hauck Mfg Co, 126 10th St, Brooklyn, N. Y.
Hays Corp, 905 8th St, Michigan City, Ind.
Adv page 195
Heacon Inc, Luzerne & 2nd Sts, Philadelphia, Pa.
Adv page 200
Illinois Engrg Co, Racine Ave. Chicago, Ill.
Johnson Service Corp, 509 E Michigan St, Milwaukee, Wis.

BIRCH PUMP VALVES



Have a metal back to withstand the pressure with rubber composition discs to seal the valve. Used for hot or cold water and guaranteed for service. Also increase pumping capacity.

With installations from small boiler feed pumps with 8 valves to 1476 valves and seats complete in individual pumps. Some city pumping stations have 7000 valves with years of continued service.

Railroads and large Industrial Corporations with chains of plants have pumps equipped with "BIRCH PUMP VALVES". Why not yours?

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MANUFACTURING CO.
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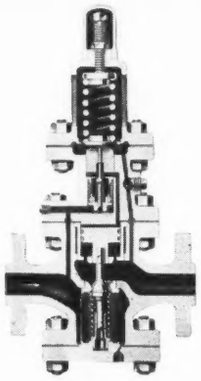
FOSTER PRESSURE REDUCING REGULATORS

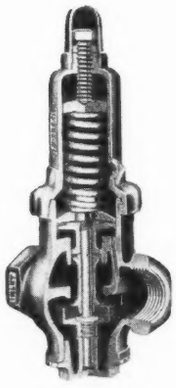


Type 37-G2S

For Steam—Type 37-G2

Built for pressures up to 1500 lbs. and 900° F. total temperature, the improved Foster Type 37-G2 Pressure Reducing Regulator assures accurate regulation despite widest variations of initial pressure. Single-seated for dead-end service, both pilot and main valve are protected by internal strainers from pipe line sediment. Streamlining of body distributes and assures free flow of steam, while construction of main valve provides maximum lift to minimize pulsating and wire drawing—affords graduated flow and modulating control. Can be fitted with either a locking cap or with a hand wheel for ready adjustment.

Type	Total Temperature Deg. Fahr.	Initial Pressure	Reduced Pressure	Spring Ranges, Pounds	Sizes, In.	Connections
		Lbs. per Sq. In.				
37-G2C	475	300	½ to 275	½–6 (LP) 3–15 (LP) 10–100	½– 2	Screwed Flanged
37-G2I	475	300	½ to 275	40–150 100–275 250–500	1¼– 4 1¼–12	Screwed Flanged
37-G2S	900	1500	½ to 1200	400–800 750–1200	½– 2 ½–12	Screwed Flanged



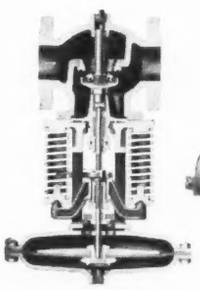
Type 38-U

For Water and Air—Type 38-U

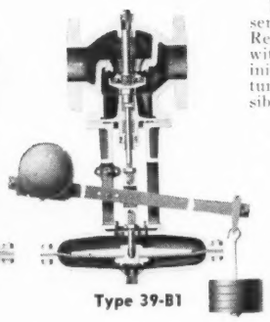
A series of five types of valves for the wide range of services requiring regulation of water and air—in power and process plants, water works, office buildings, hotels, apartment houses, and residences. All are built for total temperature of 160° F.—all are single-seated for dead-end service—all are automatically balanced so that variations in initial pressure do not affect final pressure. All have renewable main valve discs, and sizes 2½ in. and larger have renewable seat rings.

Type	Regulation	Initial Pressure	Reduced Pressure	Spring Ranges, Pounds	Sizes, In.	Connections
		Lbs. per Sq. In.				
38-U	Average	300	10–125	5– 20	½– 4	Screwed
					½– 8	Flanged
38-U1	Accurate	300	5– 80	10– 40	½– 2	Screwed
				20– 60	2½– 6	Flanged
38-U2	Accurate particularly on widely varying loads	300	5–200	40– 80	2½– 6	Flanged
				60–125	8 –24	Flanged
38-U3*	Extremely accurate under all service conditions	125	5– 80	50–200	2½– 6	Flanged

* Types 38-U3 and 38-U6 are widely used as altitude valves on two-pipe and one-pipe systems, respectively.



Type 37-A1

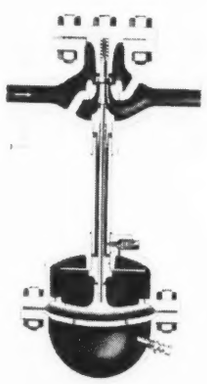


Type 39-B1

For Steam, Liquids and Gases—Types 37-A and 39-B

Built in six types for the widest range of services, Foster Types 37-A and 39-B Pressure Reducing Regulators assure accurate regulation without constant cleaning. All are available for initial pressures up to 250 lbs. and total temperatures of 475° F. All are so designed that the possibility of sticking and scoring from scale, sediment and dirt is negligible. The double spring-load Type 37-A Regulators have definite advantages over the ordinary regulator with the conventional single spring while sensitivity at low reduced pressures is assured by the Type 39-B Regulators. Both classes are made single-seated for dead-end service and double-seated for continuous service.

Type	Service	Regulation	Initial Pressure	Reduced Pressure	Sizes, In.	Connections
			Lbs. per Sq. In.			
37-A1 and 39-B1	Dead-end	Accurate where initial pressures are relatively constant	250	5–125 0–25	½–2 1–6	Screwed Flanged
37-A9 and 39-B9	Dead-end	Accurate where initial pressures are widely variable	250	5–125 0–25	½–2 1–6	Screwed Flanged
37-A2 and 39-B2	Continuous flow	Extremely accurate under all service conditions	250	5–125 0–25	½–2 1–12	Screwed Flanged



Type 39-Q1
(Type 39-Q2
Double Seated)

For Steam, Liquids and Gases—Type 39-Q1

Here is one of the latest developments in pressure-reducing regulators—an air-loaded-dome design for the accurate regulation of high and low pressure fluids, whether steam, liquids, or gases.

Built for initial pressures up to 2500 lbs. per sq. in. and temperatures up to 1000° F., this valve will handle pressure reductions of a magnitude previously impractical in a single stage.

There are no operating springs in this simple, single-seated regulator. A constant loading is imposed by air, thereby insuring constant regulation. Accuracy is unaffected by spring deflection and hysteresis, and its simplicity by the complicated pilot designs commonly used to overcome these inaccuracies.

Features —

(1) Accurate and sensitive regulation insured by constant air load in dome.

(2) Single seated for dead-end service—and shuts in direction of flow for tight closure.

(3) Simple to set over the widest range of pressures. There are no springs to adjust or change.

(4) Affords single-stage reductions of extreme magnitude—and operates without hunting or chattering.

(5) *Safe*—the diaphragm is shielded from differential pressure stress; should it fail, the pressure across it equalizes and closes the valve.

(6) Less friction, less maintenance. There are a minimum of moving parts, no large sliding surfaces or side thrusts, and no stuffing boxes to bind or to pack.

(7) All parts are readily accessible and renewable. The thorough-bolted construction of diaphragm chamber simplifies inspection. No special tools are required.

Because of these and other features, the Foster Type 39-Q1 Pressure Reducing Regulator has the widest range of applications—in power and process plants, refineries, paper mills, packing plants, rubber factories, and in marine service—wherever extreme accuracy of regulation is required under rapidly and widely varying loads.

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Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Mercon Regulator Co, 2357 N 29th St, Milwaukee, Wis.
Minneapolis - Honeywell Regulator Co, 4490 Wayne Ave, Phila, Pa.
Monarch Mfg Works, 2731 E Westmoreland St, Phila, Pa.
Mueller Co, Decatur, Ill.
Natural Gas Equip Inc, 539 Petroleum Bldg, Los Angeles, Cal.
Norgren, C A, Co, 210 Santa Fe Drive, Denver, Colo.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Powell, Wm, Co, Cincinnati, O.
Adv pages 152, 153
Reading-Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Republic Flow Meters Co, 2222 Diversey Pkwy, Chicago, Ill.
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Ruggles-Klingemann Mfg Co, Salem, Mass.
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schutte & Koerting Co, 12th & Thompson Sts, Philadelphia.
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Staples & Pfeiffer, Ltd, 528 Bryant St, San Francisco, Calif.
Sterling Engineering Co, Milwaukee, Wis.
Stickle Steam Specialties Co, 2217 Valley Ave, Indianapolis, Ind.
Strong, Carlisle & Hammond Co, 1392 W 3rd, Cleveland, O.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Tagliabue, C J, Mfg Co, Park & Nostrand Aves, Brooklyn, N. Y.
Taylor Instrument Cos, Rochester, N. Y.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Triplex Heating Specialty Co, Peru, Ind.
Tryco Products Inc, 1 Railroad Ave, Westfield, Mass.
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Watson-Stillman Co, Roselle, N. J.
Adv page 207

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Ashton Valve Co, 165 First St, Cambridge, Mass.
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Imperial Brass Mfg Co, 514 S Racine Ave, Chicago, Ill.
Jenkins Bros, 80 White St, New York, N. Y.
Adv pages 110, 111
Lunkenheimer Co, PO Box 360, Annex Sta, Cincinnati, Ohio
Adv pages 30, 31
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Mueller Brass Co, 1925A Lapeer Ave, Port Huron, Mich.
Reading, Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
York Ice Machy Corp, York, Pa.

VALVES, REFRIGERATION, EXPANSION

Alco Valve Co, 2628 Big Bend Blvd, St Louis, Mo.
Cash, A W, Co, 402 N Eldorado St, Decatur, Ill.
Adv pages 192, 235, 250, 253
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Detroit Lubricator Co, 5900 Trumbull Ave, Detroit, Mich.
Frigidaire Commercial & Air Cond Div, Dayton, Ohio
Heacon Inc, Luzerne & 2nd Sts, Philadelphia, Pa.
Adv page 200
Peerless of America, Inc, Marion, Ind.
Taylor Instrument Cos, 95 Ames St, Rochester, N. Y.
Vogt, Henry, Machine Co, 1000 W Ormsby St, Louisville, Ky.
Adv page 174
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55
York Ice Mach Corp, York, Pa.

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Birch Mfg Co, 1523 Sedgwick St, Chicago, Ill.
Adv page 254
Brown Instrument Co, 4490 Wayne Ave, Philadelphia, Pa.
Adv pages 220, 230, 231, 244
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Adv pages 192, 235, 250, 253
Coale Muffler & Safety Valve Co, Baltimore, Md.

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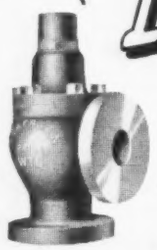

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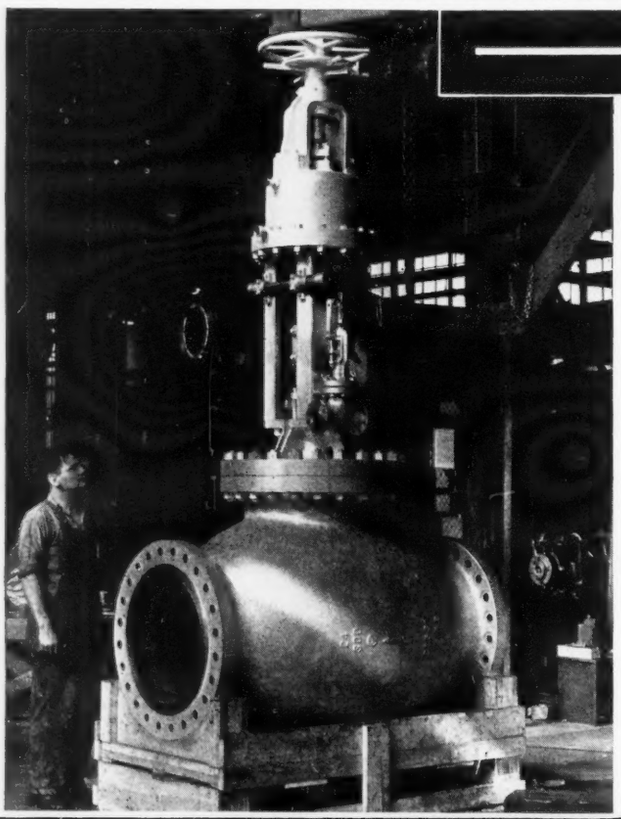

VALVES

Regulating and Pressure Reducing

For your key jobs, where valves must not fail—where they must continuously and accurately regulate the pressures and flows of steam and water on which other vital processes depend—Republic-Smoot valves give you the dependability you need.

ANY STEAM CONDITIONS

These valves are of the gradual-opening, high-lift, double-seated type, lever or hydraulic-operated, built to A. S. A. standards for steam conditions up to 1500 lb. per sq. in., 950 F and capacities up to 1,000,000 lb. of steam an hour.

STABLE REGULATION

Republic-Smoot valves will regulate accurately from maximum flow down to 2 per cent of maximum.

CUSTOM-MADE CONSTRUCTION

Republic-Smoot valves are built for any piping condition, with inlet and outlet sizes proportioned for specific pressure reductions. Special steels are used, depending on service requirements.

ONE-PIECE STEM

Valve stem and discs are machined from a single stainless steel forging.

Let a Republic Engineer consult with you on your specific pressure and flow regulating problems.

FOR COMPLETE DETAILS WRITE FOR BULLETIN No. S-40

REPUBLIC FLOW METERS CO. 2222 DIVERSEY PKWY. CHICAGO, ILLINOIS

Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Crosby Steam Gage & Valve Co, 40 Church St, New York, N. Y.
Davis Regulator Co, 2540 S Washtenaw Ave, Chicago, Ill.
Adv pages 235, 240, 252
Edward Valve & Mfg Co, 1150 W 145th St, East Chicago, Ill.
Foster Engrg Co, 109 Monroe St, Newark, N. J.
Adv pages 210, 234, 253, 254a
Golden Anderson Valve Specialty Co, 1315 Fulton Bldg, Pittsburgh, Pa.
Adv page 132
Hancock Valve Div, 143 Elias St, Bridgeport, Conn.
Jarecki Mfg Co, Erie, Pa.
Jenkins Bros, 80 White St, New York, N. Y.
Adv pages 110, 111
Kennedy Valve Mfg Co, Elmira, N. Y.
Klipfel Mfg Co, 2651 W Harrison St, Chicago, Ill.
Kunkle Valve Co, Fort Wayne, Ind.
Leahy Mfg Co, Los Angeles, Calif.
Lonergan, J E, Co, 211 Race St, Philadelphia, Pa.
Adv pages 209, 254b
Ludlow Valve Mfg Co, Ft of Adams St, Troy, N. Y.
Adv page 268
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, Ohio
Adv pages 30, 31
Mason-Neilan Regulator Co, 1186 Adams St, Boston, Mass.
Adv page 309
Manning, Maxwell & Moore, Bridgeport, Conn.
McDonnell & Miller, Wrigley Bldg, Chicago, Ill.
Mercoid Corp, 4229 Belmont Ave, Chicago, Ill.
Northern Equipment Co, 1221 Grove Drive, Erie, Pa.
Adv page 113
Pittsburgh Valve & Fittings Corp, Barberton, Ohio
Powell, Wm, Co, Cincinnati, O.
Adv pages 152, 153
Reading-Pratt & Cady Div, Reading, Pa.
Adv pages 166, 167
Ruggles-Klingemann Mfg Co, Salem, Mass.
Schade Valve Mfg Co, 2527 N Bodine St, Philadelphia, Pa.
Schutte & Koerting Co, 12th & Thompson Sts, Phila, Pa.
Watson-Stillman Co, Roselle, N. J.
Adv page 207
Westinghouse Air Brake Co, Wilmerding, Pa.

VARNISHES, INSULATING

Bakelite Corp, 247 Park Ave, New York, N. Y.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Keystone Varnish Co, 71 Otsego St, Brooklyn, N. Y.
Sherwin-Williams Co, Cleveland, Ohio
Tropical Paint & Oil Co, Cleveland, Ohio
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

VENTILATING SYSTEMS, VENTILATORS

Allen, E H, Co, Dept P, 22 Dorrance St, Boston, Mass.
American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
American Foundry Equipment Co, Mishawaka, Ind.
Arex Co, 333 N Michigan Ave, Chicago, Ill.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
De Bothezat Ventilating Equipment Div, East Moline, Ill.
Diehl Mfg Co, Elizabethport, N. J.
Garden City Fan Co, 332 S Michigan Ave, Chicago, Ill.
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Hastings Air Conditioning Co, Hastings, Neb.
Ilg Electric Ventilating Co, Chicago, Ill.
Iona Ventilator Co, 2821–29 Dauphin St, Philadelphia, Pa.
Johns-Manville, 22 E 40th St, New York, N. Y.
Adv pages 48, 49
Kirk & Blum Mfg Co, Spring Grove Ave, Cincinnati, O.
Nesbitt, John J, Inc, State Rd & Rhawn St, Philadelphia, Pa.
South Bend Air Products Inc, 322 E Colfax Ave, South Bend, Ind.
Adv page 255
Sturtevant, B F, Co, 47 Readville St, Boston, Mass.
Swartwout Co, 18511 Euclid Ave, Cleveland, Ohio
Adv page 310
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Wagner Electric Corp, St Louis, Mo.
Wing, L J, Mfg Co, W 14th St & 7th Ave, New York, N. Y.
Adv page 182

VOLTMETERS

Bristol Co, Waterbury, Conn.
Esterline Angus Co, Box 596, Indianapolis, Ind.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Roller-Smith Co, 1766 Market St, Bethlehem, Pa.
Adv page 242
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv page 54, 55
Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark, N. J.
Adv pages 181, 243

WALLS, BOILER-FURNACE, AIR-COOLED

Acme Brick Co, Fort Worth, Tex.
American Arch Co, Inc, 68 E 42nd St, New York, N. Y.
Bernitz Furnace Appliance Co, 89 Broad St, New York, N. Y.
Bigelow-Liptak Corp, 2840 W Grand Blvd, Detroit, Mich.
Chicago Fire Brick Co, 1463 Elston Ave, Chicago, Ill.
Detrick, M H, Co, 140 S Dearborn, Chicago, Ill.
DeWolf Furnace Corp, 77 South Ave, Rochester, N. Y.
Adv page 254-c
Drake Non-Clinkering Furnace Block Co, Beekman St, New York, N. Y.
Engineer Co, 75 West St, New York, N. Y.
Adv pages 144, 148
Furnace Economy Co, 201 N Wells St, Chicago, Ill.
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Laclede-Christy Clay Products Co, 411 N 7th, St Louis, Mo.
McLeod & Henry Co Inc, 31 Monroe St, Troy, N. Y.
Plibrico Jointless Firebrick Co, 1818 Kingsbury, Chicago, Ill.
Adv pages 181, 232, 254c
Ramtite Co, 2563 W 18th St, Chicago, Ill.
Reintjes, Geo P, Co, 2517 Jefferson, Kansas City, Mo.
Seaboard Refractories Co, Box 151, Perth Amboy, N. J.

WALLS, BOILER-FURNACE, WATER-COOLED

Acme Brick Co, Fort Worth, Tex.
American Engrg Co, Aramingo Ave, Philadelphia, Pa.
Adv pages 16, 17
Babcock & Wilcox Co, 85 Liberty St, New York, N. Y.
Adv pages 4, 5, 6, 7, 34
Bernitz Furnace Appliance Co, 89 Broad St, New York, N. Y.
Bigelow Co, 200-220 River St, New Haven, Conn.
Bigelow-Liptak Corp, 2840 W Grand Blvd, Detroit, Mich.
Combustion Engrg Co, Inc, 205 Madison Ave, New York, N. Y.
Adv pages 38, 39
Edge Moor Iron Works, 30 Rockefeller Plaza, New York, N. Y.
Adv page 263
Foster Wheeler Corp, 165 Broadway, New York, N. Y.
Adv page 28
Keeler, E, Co, Williamsport, Pa.
Adv page 139
Kennedy-Van Saun Mfg & Engrg Corp, 2 Park Ave, New York, N. Y.
Plibrico Jointless Firebrick Co, 1818 Kingsury, Chicago, Ill.
Adv pages 181, 232, 254c
Riley Stoker Corp, 999 Nepon-set St, Worcester, Mass.
Adv pages 90, 91
Springfield Boiler Co, 1903 E Capitol Ave, Springfield, Ill.
Union Iron Works, Erie, Pa.

WASHERS, AIR

American Blower Corp, 6000 Russell St, Detroit, Mich.
Adv pages 164, 165
Ballantyne Co, 222 N 16th Omaha, Neb.
Buffalo Forge Co, 488 Broadway, Buffalo, N. Y.
Adv page 279
Clarage Fan Co, 619 Porter St, Kalamazoo, Mich.
Adv page 203
Kauffman Air Conditioning Corp, St Louis, Mo.
Trane Co, 2012 Cameron Ave, La Crosse, Wis.
Vilter Mfg Co, 2217 S 1st St, Milwaukee, Wis.
York Ice Machy Corp, York, Pa.

WATER COLUMNS

Bordo, L J, Co, 115 New St, Glenside, Pa.
Crane Co, 836 S Michigan Ave, Chicago, Ill.
Adv page 109
Corning Glass Works, Dept IP, Corning, N. Y.
Diamond Power Specialty Corp, Box 288, Detroit, Mich.
Adv pages 12-13
Ernst Water Column & Gage Co, Livingston, N. J.
Adv pages 29, 146

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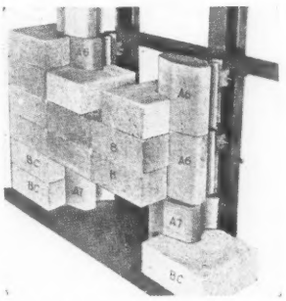

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At moderate cost, can be adapted to existing boilers as well as new settings. Simple, inexpensive steel work is employed; no expensive cast-iron hangers or special tile are necessary. Plibrico air-cooled center wall readily installed for battery settings. Catalog free.

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Everything Electrical
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Jarecki Mfg Co, Erie, Pa.
Lunkenheimer Co, Box 360, Annex Station, Cincinnati, Ohio
Adv pages 30, 31
Reliance Gauge Column Co, 5902 Carnegie Ave, Cleveland, Ohio
Schaub, Fred H, Engrg Co, 325 W Huron St, Chicago, Ill.
Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland, O.
Union Iron Works, Erie, Pa.
Williams Gage Co, 1938 Penna. Ave, N S, Pittsburgh, Pa.
Adv page 253
Wright-Austin Co, Detroit, Mich.
Yarnall-Waring Co, Chestnut Hill, Philadelphia, Pa.
Adv pages 103, 217, 222, 252, 254d

WATER-TEST KITS

(See Feedwater-Test Kits)

WATER TREATMENT, BOILER

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Sand-Banum Co, Dept M P, 9 Rockefeller Plaza, New York, N. Y.
Adv page 255
Arrow Boiler Compound Co, 3341 Pennsylvania Ave, St Louis, Mo.
Betz W H & L D, Gillingham & Worth Sts, Philadelphia, Pa.
Adv pages 187, 188, 204, 255
Buromin Co, 300 Ross St, Pittsburgh, Pa.
Chemical Solvent Co, P O Box 487, Birmingham, Ala.
Cochrane Corp, 3106 N 17th St, Philadelphia, Pa.
Adv pages 212, 218, 238, 246
Dearborn Chemical Co, 310 S Michigan Ave, Chicago, Ill.
Elgin Softener Corp, 130 N Grove St, Elgin, Ill.
Adv page 238
Feedwaters, Inc, 140 Cedar St, New York, N. Y.
Filtrators Co, 96 Liberty St, New York, N. Y.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Hall Laboratories, Inc, 300 Ross St, Pittsburgh, Pa.
Adv pages 117, 149
International Filter Co, 325 W 25th Place, Chicago, Ill.
Loomis-Manning Filter Mfg Co, 1421 S 37th St, Phila, Pa.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Monsanto Chemical Co, St Louis.
National Aluminate Corp, 6222 W 66th Place, Chicago, Ill.
Adv page 107
North American Fibre Prod Co, Cleveland, Ohio
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Permutit Co, Dept A, 330 W 42nd St, New York, N. Y.
Adv page 125
Philadelphia Quartz Co, 121 S 3rd St, Philadelphia, Pa.
Proportioneers Inc, 7 Codding St, Providence, R. I.
Rice, Cyrus Wm, & Co, 15 Noble Ave, Pittsburgh, Pa.
Stover Steel Tank & Mfg Co, Freeport, Ill.
Warley, Thos C, & Co, 217 Bainbridge St, Phila, Pa.
Western Chemical Co, 714 Washington St, Kansas City, Mo.
Water Treatment Co of America, 1159 Hodgkiss St, Pittsburgh, Pa.
Adv page 136

WATER TREATMENT, CONDENSER, COOLING CIRCUIT

Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv pages 11, 19, 37, 43
American Sand-Banum Co, Dept MP, 9 Rockefeller Plaza, New York, N. Y.
Adv page 255
Betz, W H & L D, Gillingham & Worth Sts, Philadelphia, Pa.
Adv pages 187, 188, 204, 255
Chemical Solvent Co, Box 487, Birmingham, Ala.
Chloramine Corp, 101 Park Ave, New York, N. Y.
Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.
Adv page 238
Feedwaters Inc, 140 Cedar St, New York, N. Y.
Haering, D W, & Co, 205 W Wacker Drive, Chicago, Ill.
Hall Laboratories Inc, 300 Ross St, Pittsburgh, Pa.
Adv pages 117, 149
International Filter Co, 325 W 25th Pl, Chicago, Ill.
Loomis-Manning Filter Mfg Co, 1421 S 37th St, Phila, Pa.
Madden, P E, & Co, 352 W Walton St, Chicago, Ill.
Monsanto Chemical Co, St Louis, Mo.
National Aluminate Corp, 6222 W 66th Pl, Chicago, Ill.
Adv page 107
Oakite Products Inc, 23 Thames St, New York, N. Y.
Perolin Co of N. Y., 551 5th Ave, New York, N. Y.
Philadelphia Quartz Co, 121-124 S 3rd St, Phila, Pa.
Proportioneers, Inc, 7 Codding St, Providence, R. I.
Wallace & Tiernan Co, Belleville, N. J.
Water Treatment Co of America, 1159 Hodgkiss St, Pittsburgh, Pa.
Adv page 136

WATTHOUR METERS

General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
Sangamo Electric Co, Springfield, Ill.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

WELDING AND CUTTING OUTFITS, ACETYLENE

Air Reduction Sales Co, 60 E 42nd St, New York, N. Y.
Adv pages 276, 277
Bastian-Blessing Co, 4201 Peterson Ave, Chicago, Ill.
General Welding & Equipment Co, 268 Northampton St, Boston, Mass.
Linde Air Products Co, 30 E 42nd St, New York, N. Y.
Adv page 221
Liquid Carbonic Corp, 3100 S Kedzie Ave, Chicago, Ill.
National Cylinder Gas Co, 1035 W Lake St, Chicago, Ill.
Smith Welding Equipt Corp, 2633 4th St, S E, Minneapolis, Minn.
Victor Equipment Co, 846 Folsom St, San Francisco, Calif.
Weldcraft Equipment Co, 2623 Liberty Ave, Pittsburgh, Pa.

WELDING MACHINES, ELECTRIC

Air Reduction Sales Co, 60 E 42nd St, New York, N. Y.
Adv pages 276, 277
Allen Mfg & Welding Co, Inc, Buffalo, N. Y.
Allis-Chalmers Mfg Co, Milwaukee, Wis.
Adv page 11 19, 37, 43
Burke Electric Co, Erie, Pa.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Harnischfeger Corp, Milwaukee, Wis.
Hobart Bros Co, Troy, Ohio
Ideal Commutator Dresser Co, 1025 Park Ave, Sycamore, Ill.
Ideal Electric & Mfg Co, Mansfield, Ohio
Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio
Marquette Mfg Co, 409 Johnson St, N E, Minneapolis, Minn.
Ryerson, Jos T, & Son, 16th & Rockwell Sts, Chicago, Ill.
Smith Welding Equipt Corp, 2633 4th St, S E, Minneapolis.
Weldcraft Equipment Co, 2623 Liberty St, Pittsburgh, Pa.
Westinghouse Electric & Mfg Co, E Pittsburgh, Pa.
Adv pages 54, 55

WINCHES, ELECTRIC, HAND

American Engrg Co, Aramingo Ave, Philadelphia, Pa.
Adv pages 16, 17
Bridgeport Chain & Mfg Co, Bridgeport, Conn.
Detroit Hoist & Machine Co, Detroit, Mich.
Gifford-Wood Co, 24 Hill St, Hudson, N. Y.
Lidgerwood Mfg Co, Elizabeth, N. J.
Link-Belt Co, 307 N Michigan Ave, Chicago, Ill.
Adv page 3
Markey Machinery Co, 85 Horton St, Seattle, Wash.
O K Clutch & Machine Co, Columbia, Pa.
Robins Conveying Belt Co, Passaic, N. J.
Adv page 168
Shaw-Box Crane & Hoist Div, Muskegon, Mich.
Shepard Niles Crane & Hoist Corp, 453 Schuyler Ave, Montour Falls, N. Y.
Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.
Adv pages 46, 47
Wheeler, C H, Mfg Co, Lehigh & Sedgley Aves, Phila, Pa.

WIRE AND CABLE, ELECTRIC

American Steel & Wire Co, Rockefeller Bldg, Cleveland, Ohio
Anaconda Wire & Cable Co, 25 Broadway, New York, N. Y.
Chase Brass & Copper Co, 236 Grand St, Waterbury, Conn.
General Cable Corp, 420 Lexington Ave, New York, N. Y.
General Electric Co, Schenectady, N. Y.
Adv pages 14, 15, 44, 45, 145
Graybar Electric Co, 420 Lexington Ave, New York, N. Y.
Adv pages 193, 214, 220, 221, 236, 242, 254c, 254d
National Electric Products Corp, Fulton Bldg, Pittsburgh, Pa.
Phelps Dodge Copper Products Corp, 40 Wall, New York, N. Y.
Rockbestos Products Corp, New Haven, Conn.
Adv page 275
Roebling's, John A, Sons Co, 640 S Broad St, Trenton, N. J.
Adv page 177
Willard Storage Battery Co, 246 E 131st St, Cleveland, Ohio

WIRES and CABLES

One Item of the Graybar 60,000

All types of wires and cables including Rubber-Covered, Braided and Leaded Wire, Varnished Cambric, Boiler Room Wire and Portable Cords.

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IN OVER 80 PRINCIPAL CITIES

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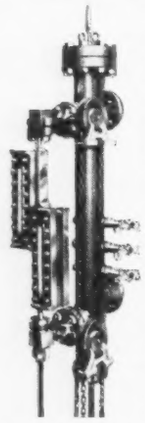
WATER COLUMNS & GAGES

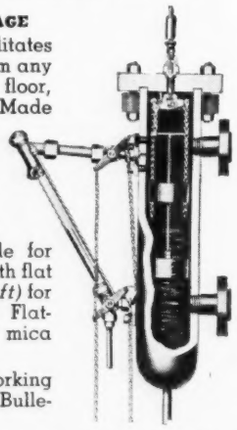
Widely used by public utilities, industrial plants and institutions. Sold as complete units or separate columns and gages.

Floatless Hi-Lo Alarm in column depends for action on displacement of balanced solid weights. Whenever high or low water level destroys balance of weights, valve in top of column opens, admitting steam to alarm whistle. Yarway Water Columns made for all pressures up to 1500 lbs.



SESURE-INCLINED GAGE

(shown at right) facilitates reading water level from any point on boiler room floor, even directly beneath. Made with round glass for pressures up to 400 lbs., with flat glass, pressures to 600 lbs.



VERTICAL GAGES

with round glass made for pressures to 400 lbs., with flat glass *(illustrated at left)* for pressures to 1500 lbs. Flat-glass steel inserts are mica protected.

Send for celluloid working model and descriptive Bulletin WG-1808.

See other Yarway Advertisements on pages 103, 217, 222 and 252

YARNALL-WARING CO.
100 MERMAID AVE., PHILA.

BOILER WATER TREATMENT . . . . . *Internal and External*

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REMOVE Old Scale PREVENT New Scale

SAND-BANUM is Guaranteed to Cure—or *NO SALE!*

You have nothing to lose in finding out how much you can gain by eliminating scale with SAND-BANUM—the tried and proved method of eliminating boiler scale *regardless* of the condition of your boiler feed water.

SAND-BANUM *guarantees* results — is harmless to equipment—absolutely safe to handle and use—does not carry over with steam—prevents priming and foaming and requires no water analysis prior to using.

It is the simple, certain, safe and economical way to treat boilers and tubes to prevent scale formation and to remove old scale.

SEND YOUR TRIAL ORDER TODAY!

TRY SAND-BANUM for 30, 60, 90 days and if you are not satisfied with results you owe us nothing.

AMERICAN SAND-BANUM CO., INC.

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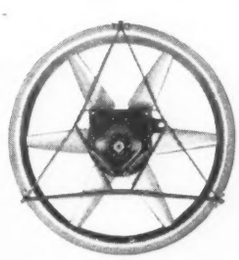
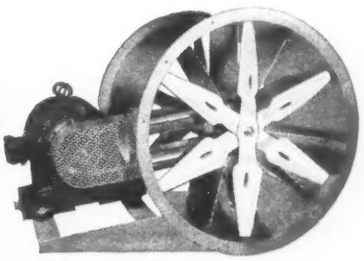
For airplane accessory manufacturer. Special 50 M.P.H. blower — two 24" dia., 6-blade fans, each driven by a ¾ H.P. adjustable speed motor. Blast velocity and direction adjustable.

ENGINEERED to meet the specific air-moving and ventilating requirements of munitions makers, armament factories, and all kinds of industrial plants, South Bend Air Products are playing a big part in national defense. • In addition to specially designed equipment like the unit illustrated above, we offer a broad range of standardized units—two shown below. Motors for use in explosive gases can be provided with all units. • Complete advisory service by competent engineers . . . Outline your problem and/or ask for descriptive material.



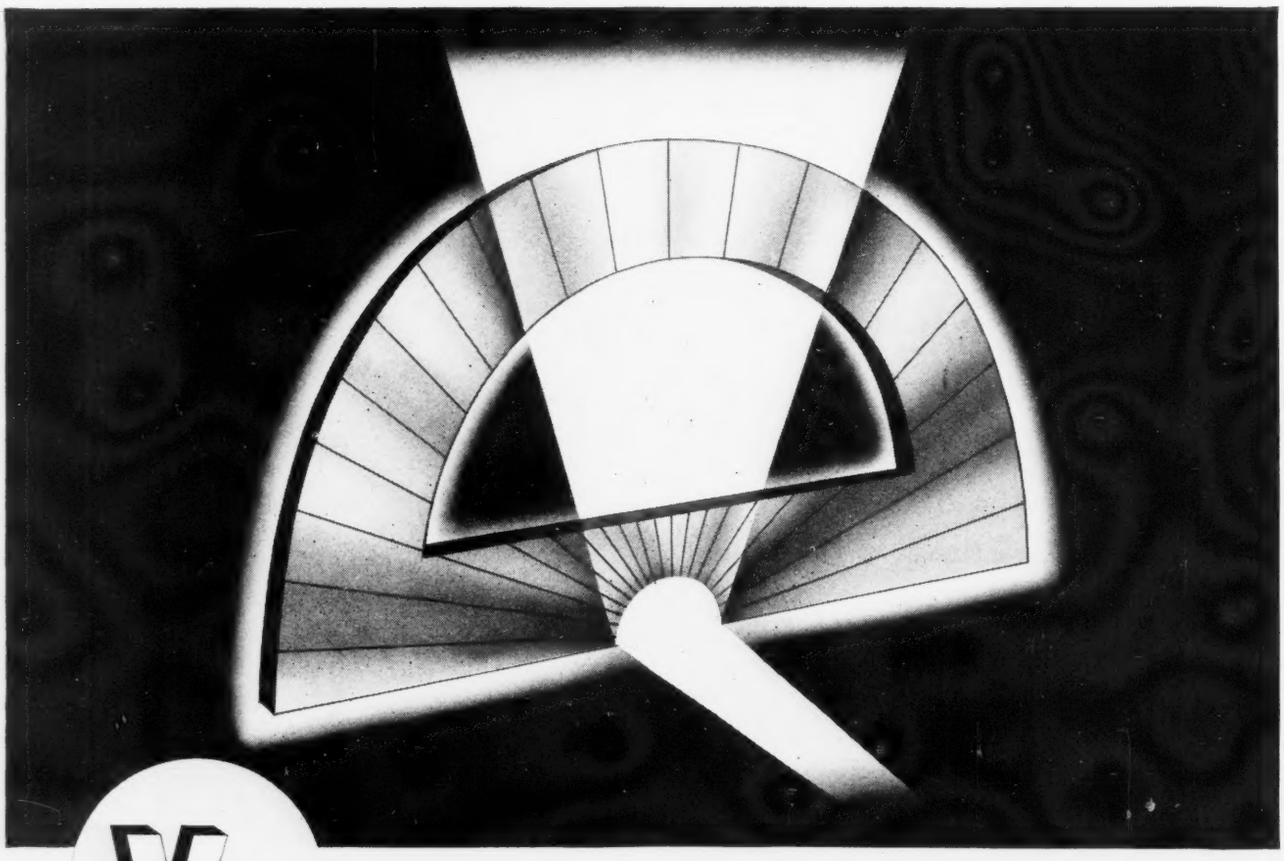
Dynaflow fans—two, four or six blade—for exhausting or blowing against moderate static pressures. 16" to 36" diameters.



Dynaflow—Ductype (Belt Driven) for use in ducts. Single or tandem fan units. 16" to 36" diameters; ⅛ to 10 H.P.

SOUTH BEND AIR PRODUCTS INC.

301 EAST COLFAX AVENUE, SOUTH BEND, INDIANA



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THE DOMINANT DRIVE OF INDUSTRY

TRADE MARK

The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence —the result of cooperative engineering, research and experience.

light on the "right" angle

The tremendous importance of apparently trifling details has been demonstrated by engineering practice times without number. And, in the matter of correct angles of the Sheaves and V-Belts used in Multiple-V-Belt Drives, this truth is most forcibly emphasized. . . . Countless laboratory experiments and field tests by Association Members were necessary to determine the precisely "right" angle to provide maximum wedging-gripping action with the least allowable tension to insure highest efficiency, plus long, uninterrupted service life of both sheaves and belts. . . . Today, the smooth, quiet functioning of thousands of Multiple-V-Belt Drives in practically every industry is accepted as a matter of fact. The arrival of the "right" angle is another example of coordinated effort by Association Members that made the Multiple-V-Belt Drive "The Dominant Drive of Industry".

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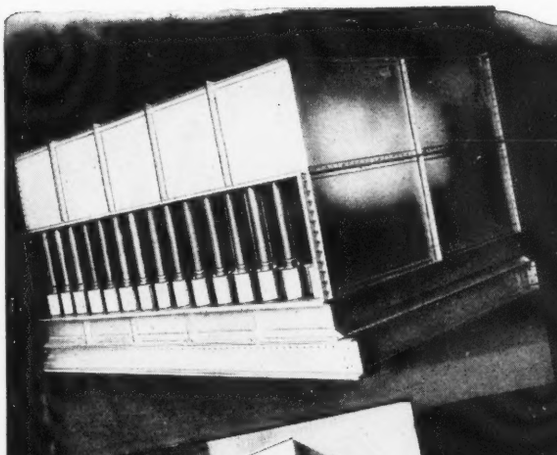
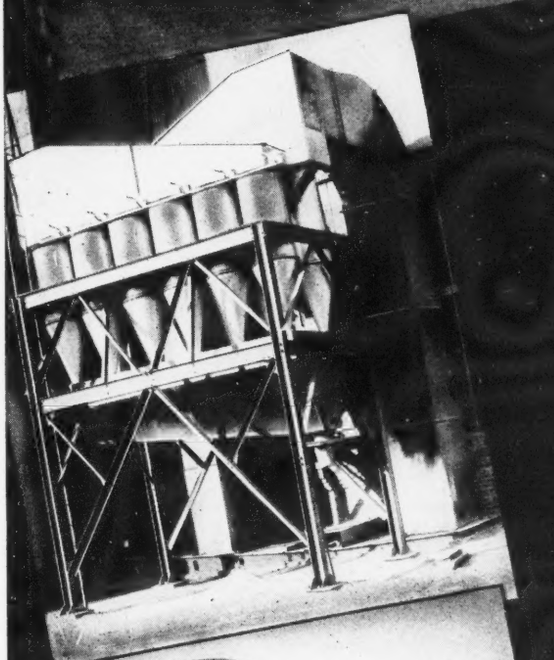
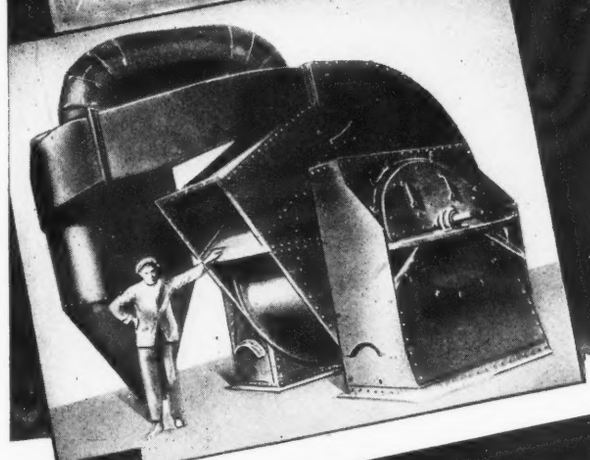
140 SOUTH DEARBORN STREET • CHICAGO







Dust Takes a Holiday-

with a Thermix

Every engineer knows that one type of dust collector will not meet every requirement. That's why Thermix Dust Collectors are made in three types.

If your space is limited, you can install a Thermix Tubular Dust Collector in approximately the space required for a horizontal flue—or it can be built in connection with a vertical flue or directly beneath an air preheater.

If the greatest efficiency is required, then the Thermix Controlled Multicyclone is our recommendation.

But if you wish to combine your induced draft fan with your dust collector—or if you wish a dust collector which overcomes its own resistance, then the Thermix Recirculator is indicated.

There is a reason, therefore, for each of the three types of Thermix Dust Collectors.

Why not ask our Research Department to recommend the correct type. They will gladly do so without obligation. Write today for catalogs Nos. 105-107.

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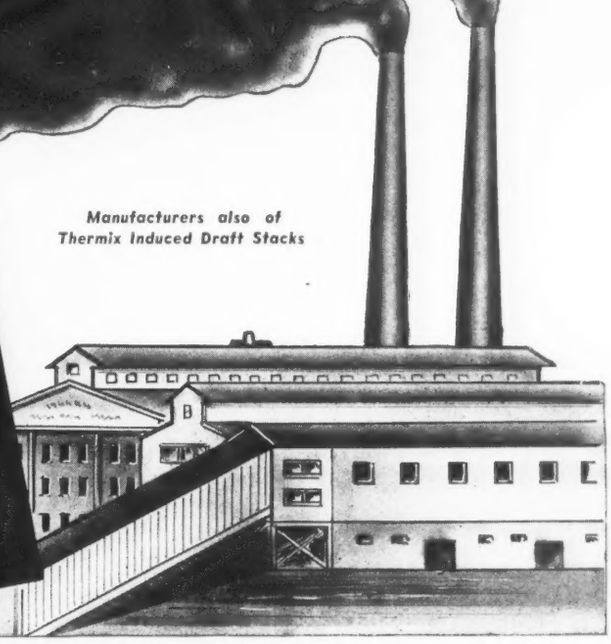
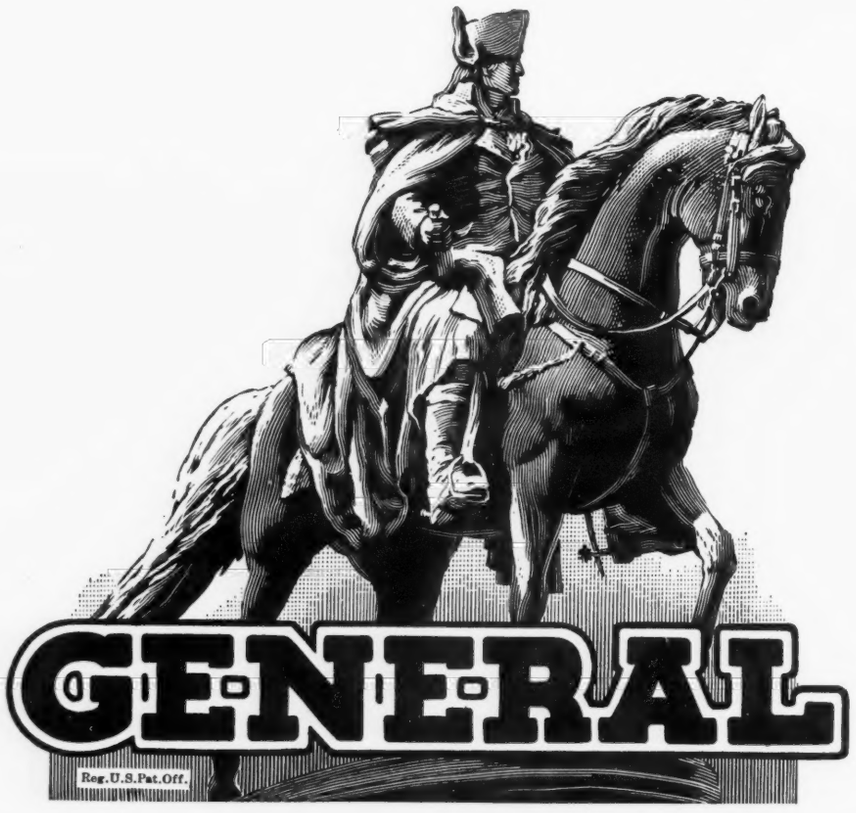
Representatives in Principal Cities

Manufacturers also of
Thermix Induced Draft Stacks

THERMIX DUST COLLECTORS





RODA — High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE — Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL (Westmoreland Coal Company) — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER — Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal — Genuine New River Smokeless, Beckley or Sewall seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky — Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

GENCO — Steam and domestic coals from a number of producing districts.

ANTHRACITE — Premium and standard qualities in the entire range of Anthracite burning characteristics.

Capable engineering personnel and the experience gained through long and varied marketing activity assures proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company

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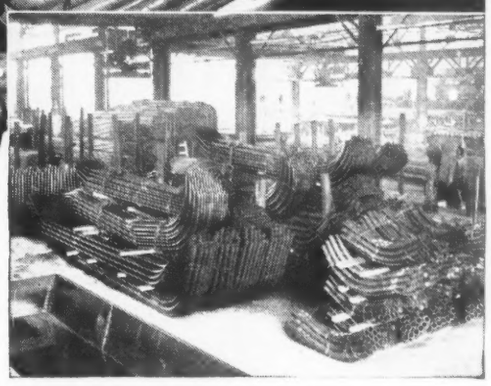
TUBES IN PACKAGES!



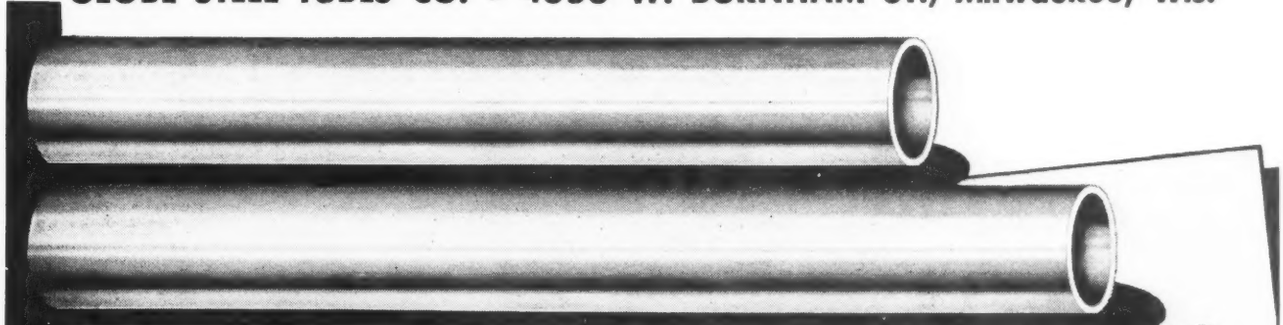
. . . GLOBE
GROUP-BUNDLING SAVES TIME — HANDLING — AND INSTALLATION COSTS

SUBSTANTIAL savings in tube-handling time and installation costs are provided by the Globe method of group-bundling of tubes previous to shipment.

All Globe tubes of the same contour are sorted, grouped, and bundled at the Globe plant before loading and shipping. This pre-sorting avoids mixing of different contour tubes — re-bending — and provides greater speed and convenience in handling at the place of installation.

This organization specializes exclusively in the manufacture of seamless steel tubes. Such concentration on one product assures the purchaser of a fast, dependable source of supply and a consistently uniform quality of tubes.

GLOBE STEEL TUBES CO. • 4050 W. BURNHAM ST., *Milwaukee, Wis.*



STAINLESS TUBES
BOILER TUBES
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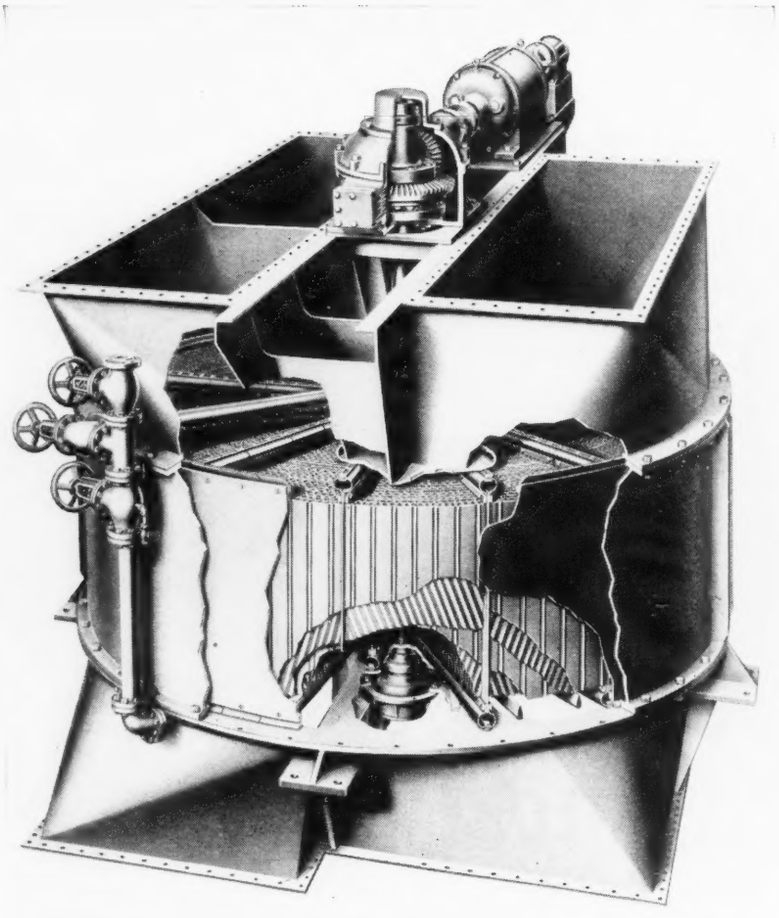
MECHANICAL TUBING

GLOBE STEEL TUBES
Seamless for Safety

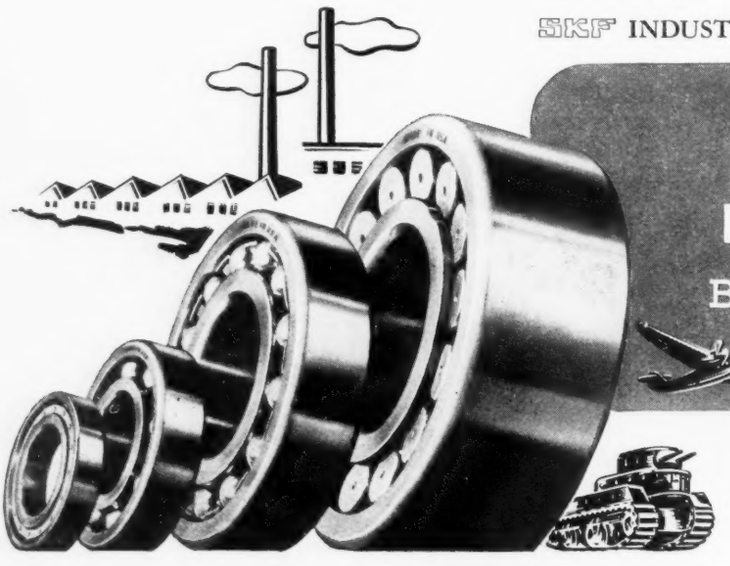
They Do It For Defense



BUILT BY THE AIR PREHEATER CORP.

Defense industries must operate at the highest possible efficiency these days. And one way to accomplish this is through the Type CGZX Ljungstrom Air Preheater that preheats combustion air for greater fuel economy and efficiency. To maintain high efficiency, this unit relies on SKF Bearings. An SKF Thrust Bearing supports the rotor. An SKF Spherical Roller Bearing takes radial loads on the bottom location. And two SKF Deep Groove Ball Bearings are mounted on the bevel pinion drive shaft. Another example of how SKF Bearings are helping Defense industries step ahead in the race with Time. 4931

SKF INDUSTRIES, INC., FRONT ST. & ERIE AVE., PHILA.



SKF

BALL AND ROLLER BEARINGS

All Taylor Forge Fittings are critically inspected for circularity of ends, accuracy of dimensions, and smoothness of inside wall.
6"STD. TAYLOR FORGE WELDELL PAT.1936805

An extra operation for us provides extra value for you in WeldELLS

ONE of the big reasons practical men prefer WeldELLS is because these *engineered* fittings line up so perfectly. And the reason WeldELLS do line up so precisely, so easily, is because every one is given a *truing operation* to bring the fitting to *exact* size before machining bevel and land. Incidentally that's also why both bevel and land are so accurate and uniform in WeldELLS.

Of course it costs us something to perform this operation—and we could "get by" without it. But we believe that the extra value provided fully justifies the expense.

So here again the Taylor Forge principles of sound engineering design, maximum simplicity, utility and economy, bring added value to users of welding fittings.

And remember that with all their extra value features Taylor Forge Fittings cost no more than other makes.

• You'll find the complete story in our big Catalog 401—216 pages of usable information and valuable engineering data. Write for it today.

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General Offices & Works: Chicago, P. O. Box 485 • New York Office: 50 Church St.
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OTHER EXTRA VALUE FEATURES

In addition to the features described opposite, WeldELLS have the following advantages which are combined in no other welding fitting:

1. **Seamless**—greater strength and uniformity.
2. **Tangents**—keep weld away from zone of highest stress—simplify lining up.
3. **Precision quarter-marked ends**—simplify layout and help insure accuracy.
4. **Permanent and complete identification marking***—saves time and eliminates errors in shop and field.
5. **Selective reinforcement**—provides uniform strength.
6. **Wall Thickness never less than specification minimum**—assures full strength and long life.
7. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
8. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

*Since the marking is pressed into the metal before forming, and since the manufacture of the fittings is carried out at a forging temperature, each in effect receives a heat treatment after the operation. The indentations have no sharp corners or edges and the marking has no effect on the strength of the fitting.

It Costs 30% TO 60% Less* TO OPERATE

Hovalco Angle Valves used in combination with (1) Homestead Lever Seald or (2) Cam Seald Quarter-Turn Valves meet the requirements of A. S. M. E. Code and all state laws for boiler blow-off service. Made in 1½"—2"—2½" sizes for pressures up to 600 pounds.

HOVALCO
"Double-Life" Blow-off Valves

*Certified reports from users of Homestead Boiler Blow-off Valves show 30% to 60% lower operating costs, as compared to valves previously used.

This extremely low upkeep, plus *double valve life* afforded by the *extra* set of ready-ground and perfectly matched high-silicon-monel seating surfaces in every Hovalco Angle Valve, is your assurance of lowest-cost-per-year valve service.

Be sure that you meet today's increased power demands by specifying and getting the unfailing service and lower costs afforded by Homestead Blow-off Valves. Select the proper sizes and types for your conditions from Homestead Valve Reference Book No. 38. A copy will be sent at your request.

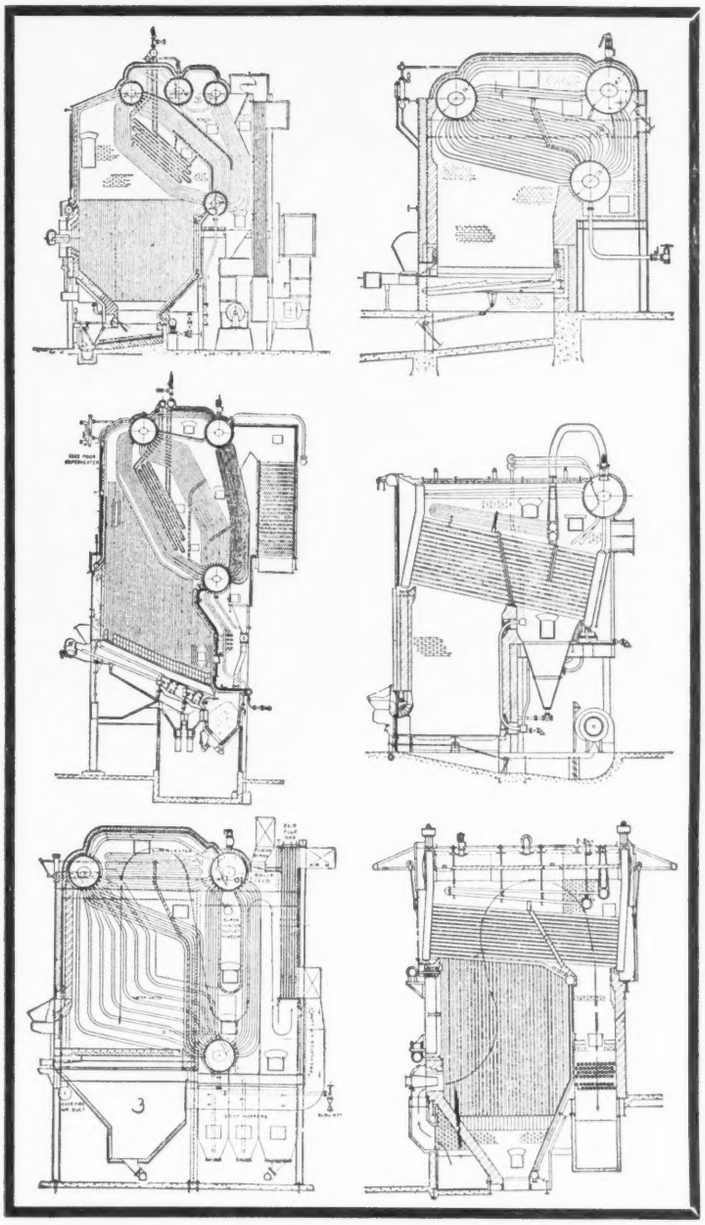
HOMESTEAD VALVE MFG. CO., P. O. BOX 210, CORAOPOLIS, PA.

HOMESTEAD VALVES

QUARTER-TURN VALVES:
STRAIGHT-WAY
THREE-WAY
FOUR-WAY
LUBRICATED TYPE
LIFT-TYPE PLUG

PROTECTED-SEAT VALVES:
HYDRAULIC (B & O PAT.) OPERATING
REMOTE CONTROL
HYDRAULIC DESCALING
ROSS AIR SHUT-OFF VALVES
HOVALCO BLOW-OFF VALVES

EDGE MOOR



WATER-TUBE BOILERS
FOR
ANY CAPACITY AND PRESSURE

The cross section illustrations shown here are those of actual Edge Moor installations and are typical of the boiler plants designed, built and placed in operation by Edge Moor.

If you are in need of extra boiler capacity quickly, Edge Moor recommends your selecting one of these designs or others which are ready for production. Any boilers previously built by Edge Moor can be duplicated promptly because with all preliminary engineering completed there would be no delays such as ordinarily occur in the development of entirely new designs.

In each of these modern plants, a high proportion of Edge Moor built equipment is included. Drums, for example, are welded in Edge Moor's own shop—tubes are formed at our own plant on special equipment. In addition, Super heaters, complete water walls, economizers, air preheaters, boiler casings and other steel work are fabricated in the Edge Moor Shop.

PROMPT, EFFICIENT SERVICE

Edge Moor is prepared to furnish and erect any and all major items of boiler plant equipment under a single contract. This includes brick work, casings, stokers, pulverizers, oil burners, fans, pumps, stacks, controls, and any other equipment required in a modern boiler installation—all in accordance with your engineer's or your consulting engineer's specifications.

Edge Moor-built equipment includes:

Bent Tube Boilers
Straight Tube Boilers
Waste Heat Boilers
Superheaters
Water Walls
Economizers
Air Preheaters

RECENT EDGE MOOR INSTALLATIONS

Army Medical Center	Washington, D. C.	Huntsville Arsenal	Huntsville, Ala.
U. S. Navy Yard	Washington, D. C.	Edgewood Arsenal	Edgewood, Md.
Philadelphia Quartermasters' Depot	Phila., Pa.	U. S. Navy Yard	Boston, Mass.

Ask Edge Moor for detailed information on boilers and boiler equipment. Take advantage of Edge Moor's long experience and modern engineering to insure maximum operating efficiency and minimum maintenance in your boiler plant.

GET THE ADVICE OF YOUR CONSULTING ENGINEER ON THE ECONOMICS OF MODERN POWER PLANTS

EDGE MOOR IRON WORKS, INC.

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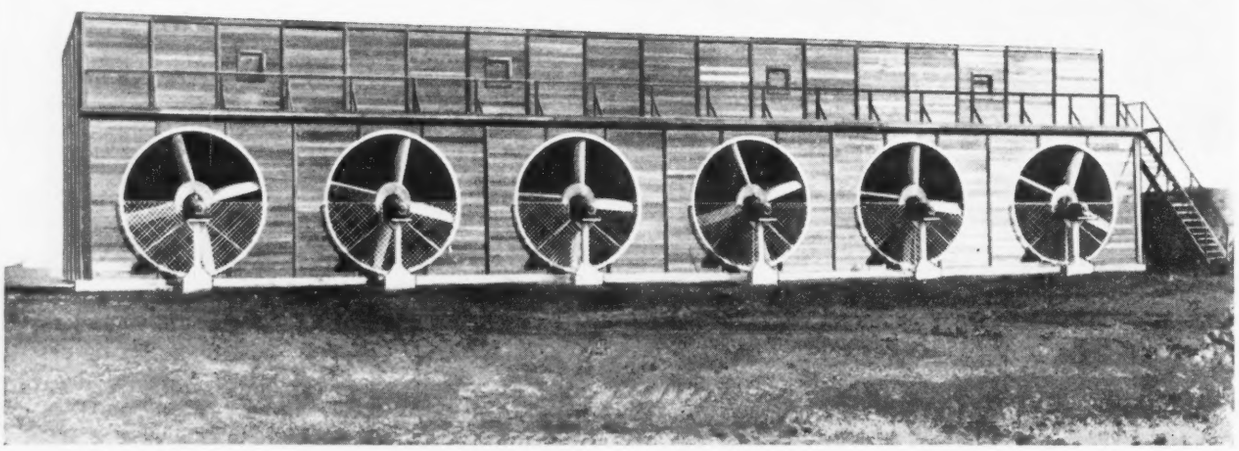
In Canada **UNITED STEEL CORPORATION, LTD.** Toronto, Montreal

DEFENSE



Against Water Cooling Inefficiency . . .

Pritchard mechanical draft towers provide the efficient, adequate water cooling that lets your plant go ahead "full steam". No "bottlenecks" due to inefficient tower operation or insufficient tower capacity.

Fan troubles vanish because Pritchard uses light weight, non-corrosive monel fans that cost less to operate and maintain and reduce driving equipment wear. Pumping costs are reasonable because of Pritchard low pressure distribution. Estimated yearly costs, based on superior construction and money saving operation, will open your eyes to true cooling tower economy.

Full details in bulletin No. 42, just off the press. Write for it today. (For atmospheric towers, request Bulletin No. 40-A.)

J. F. PRITCHARD & COMPANY

DWIGHT BUILDING **KANSAS CITY, MO.**

Branch offices in Tulsa, Okla.; Houston, Texas; Atlanta, Ga.; Chicago, Ill.; Pittsburgh, Pa.; New York City

PRITCHARD

Atmospheric and Mechanical Draft

WATER COOLING TOWERS

R/M PACKINGS ARE ON THE FIRING LINE!

Volunteering for defense—stepping in line to play a vital part in increased production—ready and able to take orders, added pressures, and increased strains, Raybestos-Manhattan packings are "in there fighting" all along the production front.

They're controlling water and gas and oil, corrosive chemicals, and steam with rugged efficiency. They're setting new standards; requiring less frequent repacking. They're proving the worth of 40 years' specialization in asbestos and rubber. They're keeping machines going at top speed with no let-up. They're standing the stress of a mighty industrial splurge, the like of which has never been seen before.

R/M packings can "take it". What they can do to speed production and keep it above capacity in other defense plants, they can do for yours. Try R/M on your next repacking job, and see for yourself!

The R/M line is the shortest *complete* line available. This simple, condensed, cross-indexed catalog has all the dope about the *right* packings for your particular needs. Ask your R/M jobber—or write us for your own free copy.

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Makers of Packings for Every Industrial Use

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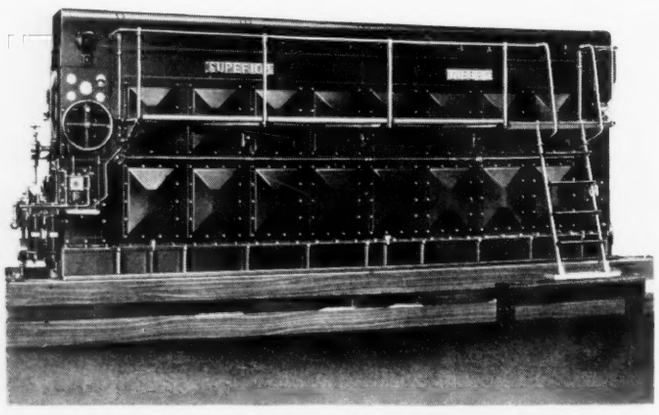
A TRIBUTE TO THE DEPENDABILITY OF *Superior* DIESELS

★ ★

Dredge "Presidente Eduardo Santos" was built complete, ready for work, for the Republic of Colombia, South America, by Ellicott Machine Corporation of Baltimore, Md.

DIESEL ENGINE MAINTENANCE is an easy matter when a telephone call will bring a service man the next day. But when the installation is thousands of miles away in South America, built-in DEPENDABILITY is the owner's only assurance of continuous, trouble-free operation.



Superior Diesel, 8-cylinder, 14½" x 20", 950 H. P., of the type installed as main engine on the "Presidente Eduardo Santos". The generator engine is a 6-cylinder, 12" x 15", 514 H. P. Superior, driving a 300 kw. generator.

Superior Diesels have an enviable record of universally successful and dependable performance in many dredge installations now operating in the U. S. That they were selected for both main engine and generator set in the "Presidente Eduardo Santos" is outstanding recognition of this record, and a tribute of which we are very proud.

YOU **can have this same factor of dependability in *your* engine room, because fifty years of engine building experience have put it into every Superior Diesel. Why not investigate?**

★ ★

THE NATIONAL SUPPLY COMPANY... SUPERIOR ENGINE DIVISION

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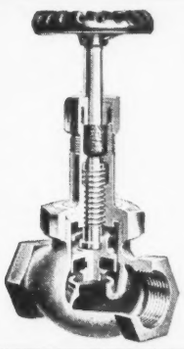
You Can Bank on Fairbanks Valves

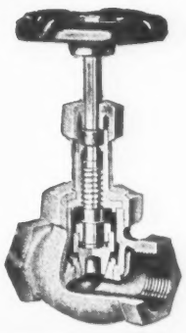
BRONZE GLOBE, UNION BONNET

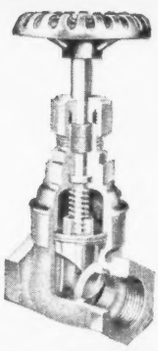
Fig. U-O1. Renewable composition disc. 150 lbs. steam working pressure. Also made in angle pattern. Sizes, ⅛ to 3 in.



BRONZE REGRINDING GLOBE

Fig. 0501-P. Plug type. Renewable nickel alloy seat and disc. 200 lbs. steam working pressure. Also made in angle pattern. Sizes, ¼ to 3 in.





BRONZE GATE

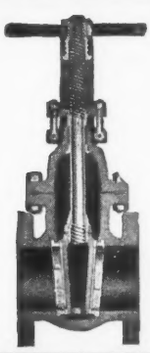
Fig. 0201. Solid wedge pattern with renewable bronze seat rings. 150 lbs. steam working pressure. Also made with flanged ends. Sizes, ½ to 3 in.

U-BOLT ALL-IRON GATE

Fig. 0418. 150 lbs. steam working pressure. Also made bronze mounted. Sizes, ½ to 4 in.

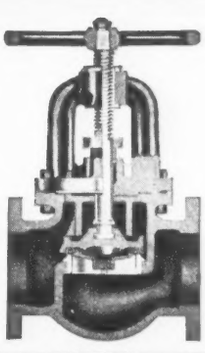
IRON BODY GATE

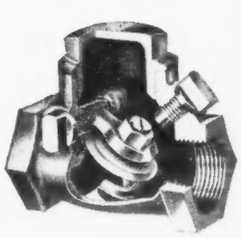
Fig. 0304. Renewable seat rings, solid wedge pattern. Stationary spindle. 150 lbs. steam working pressure. Made in Standard, Heavy and Extra Heavy pattern. Also made with screwed ends. Sizes, 2 to 24 in.



IRON BODY GLOBE

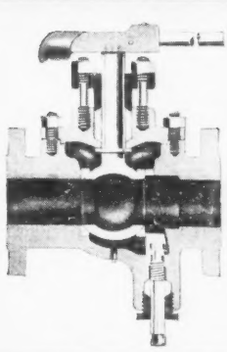
Fig. 0102. Renewable composition or regrinding disc. 150 lbs. steam working pressure. Also made in angle type and in Heavy and Extra Heavy pattern. Sizes, 2 to 12 in.





BRONZE SWING CHECK

Fig. 0601. 150 lbs. steam working pressure. Made in Standard, Heavy and Extra Heavy pattern. Sizes, ¼ to 3 in.



BALL-PLUG TYPE

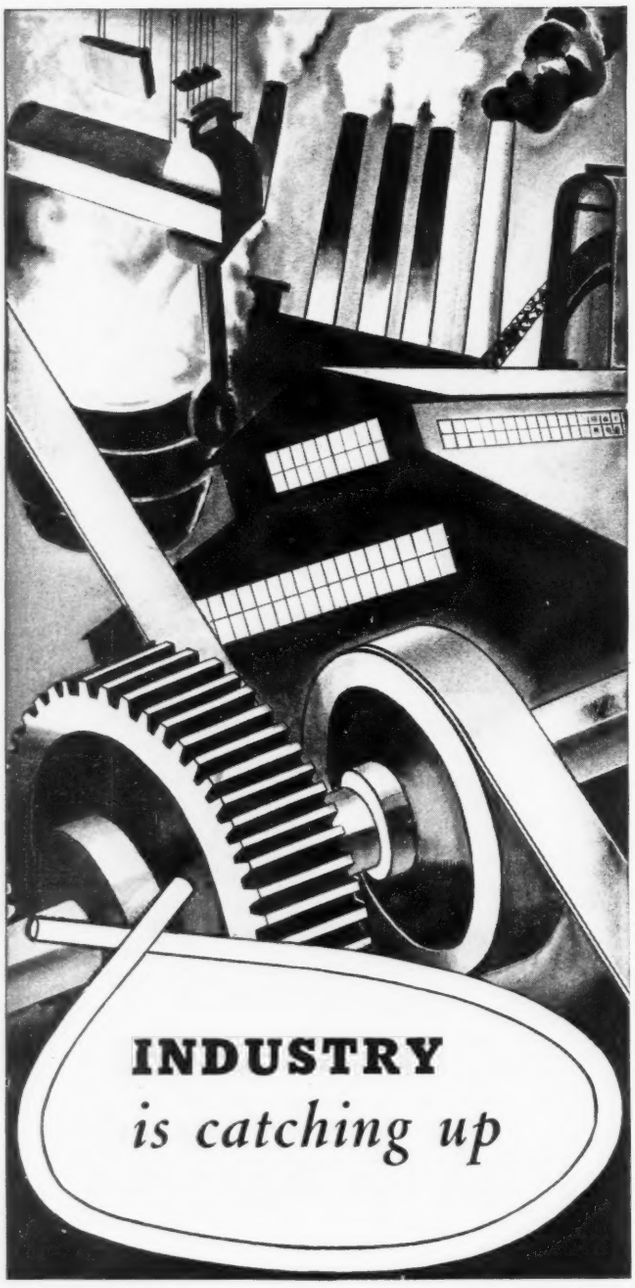
Fig. 0851. With quarter stop. 250 lbs. steam working pressure. Also made with screwed ends and with worm gear attachment. Sizes, ½ to 8 in.

Write for our interesting catalog 21. It illustrates and describes more than 140 valves

THE FAIRBANKS COMPANY

397 Lafayette Street, New York, N. Y.

Boston, Pittsburgh • Distributors in Principal Cities



WE'VE always boasted about having the "world's fastest complete boiler tube service" and now the increased industrial activity keeps us stepping to make good. But we're still out in front ready to furnish boiler tubes to fit your exact specifications. Let us show you how our speed and accuracy save you time and money. Write for quotation.

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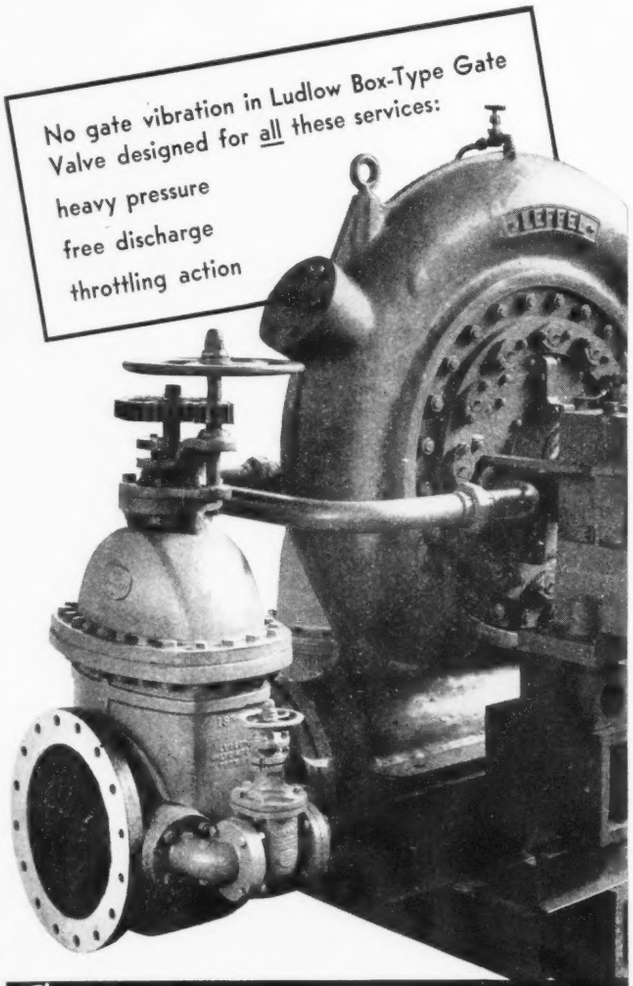
"World's Fastest Complete Boiler Tube Service"

NO GATE VIBRATION

The main valve shown connected to the turbine is an example of Ludlow design for special service. This type of installation calls for free discharge as well as throttling service at high pressure. Ludlow installed a box-type gate valve. The sturdy construction of the single gate, the bronze guides, and the fact that the stem is solidly connected to the gate, all serve to prevent vibration and insure long and dependable valve life.

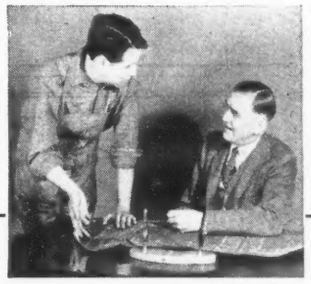
Ludlow's knack of knowing how is based on years of experience in the valve field. Why not put this experience to work for you? The Ludlow engineering staff is at your service for consultation without obligation.


No gate vibration in Ludlow Box-Type Gate Valve designed for all these services:
heavy pressure
free discharge
throttling action

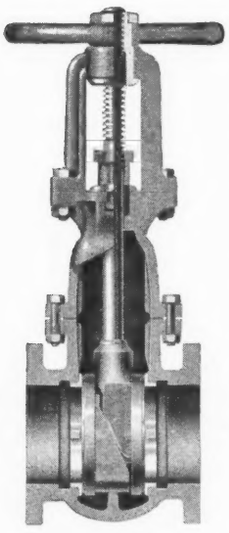
The LUDLOW VALVE MFG·CO·INC· TROY·N·Y· SINCE 1866

DARLING VALVES

INSTALL THEM



PROFIT BY THEM!

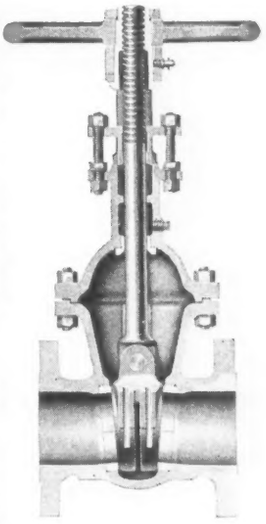


DOUBLE DISC PARALLEL SEAT GATE VALVES

The unique revolving disc assures maximum life under all service conditions. Plain, no-pocket discs and wedges prevent accumulation of scale or sludge, and discs are free to revolve throughout their entire travel. Simple assembly involves no links, guides, or other auxiliaries. Parts cannot be incorrectly assembled, cannot disengage in service. Replacements can be made without removing the valve from the line. Either disc operates equally well against pressure. Transversely beveled wedge faces assure uniform distribution of wedging pressure against backs of discs. Upper wedge also has a radius face which provides a line contact when wedges are expanded.

Available in a wide variety of pressure ratings. Made of High Strength Darvaliron, Bronze, Cast Steel, or Forged Steel.

CAST STEEL WEDGE GATE VALVES



These valves are designed with optional features to meet varying operating conditions.

The improved one-piece slotted wedge permits flexibility, and assures tight seating at all times, regardless of temperature and pressure. Double grooves on each side of the wedge engage twin guides on the valve body and provide extra large bearing area for the wedge.

On yoke valves, a hinged connection between stem and wedge assures accurate seating of the wedge without side strain.

Solid wedges are optional on all valves. Optional features on outside screw and yoke valves include I-section wedges and T-slot connections between stems and wedges.

Available in standard pressure ratings. Made of carbon or alloyed steels, with mountings to suit the service conditions.

DARLING'S SPECIAL ALLOYS FOR CORROSIVE SERVICE

have solved difficult valve problems in many industries. Darling Engineers will gladly study your corrosion conditions and make specific recommendations on suitable materials and designs for all services.

CYLINDER OPERATED VALVES

Darling Valves equipped with operating cylinders actuated by water, air, or gas are particularly useful in plants where valves installed in inaccessible locations are to be operated individually or in batteries.

CHECK VALVES

The vertical seat and revolving disc are but two of the unique design features that give maximum check valve performance when Darling Swing Check Valves are used.

MOTOR OPERATED VALVES

Motor control units installed on Darling Valves are especially adapted for use where remote control or automatic operation is desirable. Darling Motor Operated Valves are giving exceptional performance in many water works, pipe lines, and industrial plants under a variety of operating conditions.

DARLING FIRE HYDRANTS

Darling Fire Hydrants are the compression type, closing with the pressure, and are available for both standard and high pressure fire lines. The simplicity of design, rugged construction, and extra large barrel assures maximum protection with minimum maintenance. Send for descriptive literature.

DARLING

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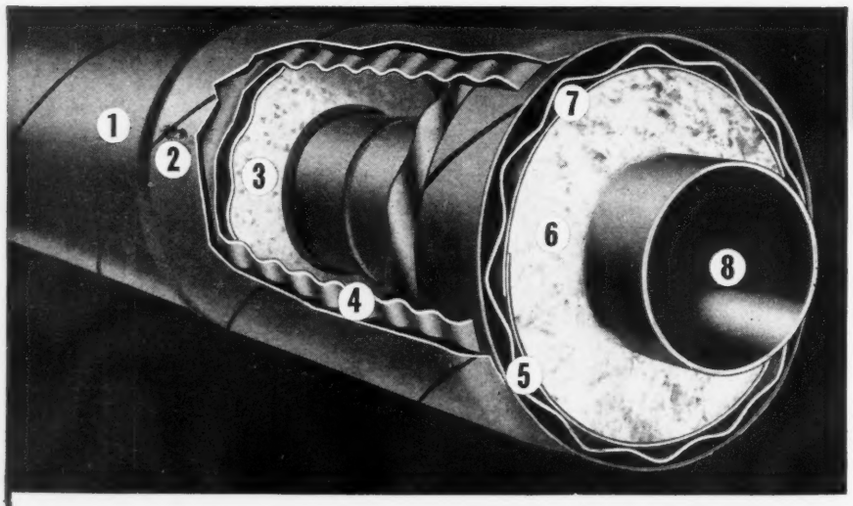

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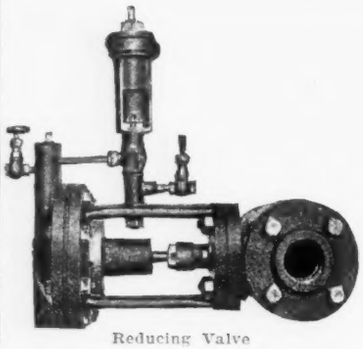
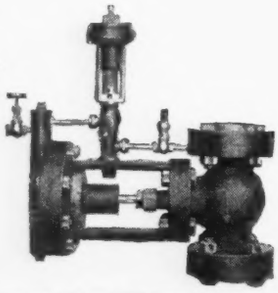


Reducing Valve



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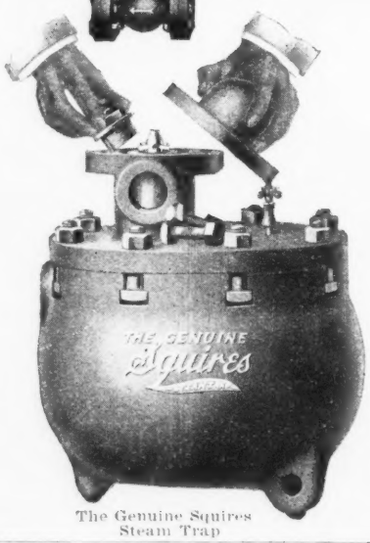
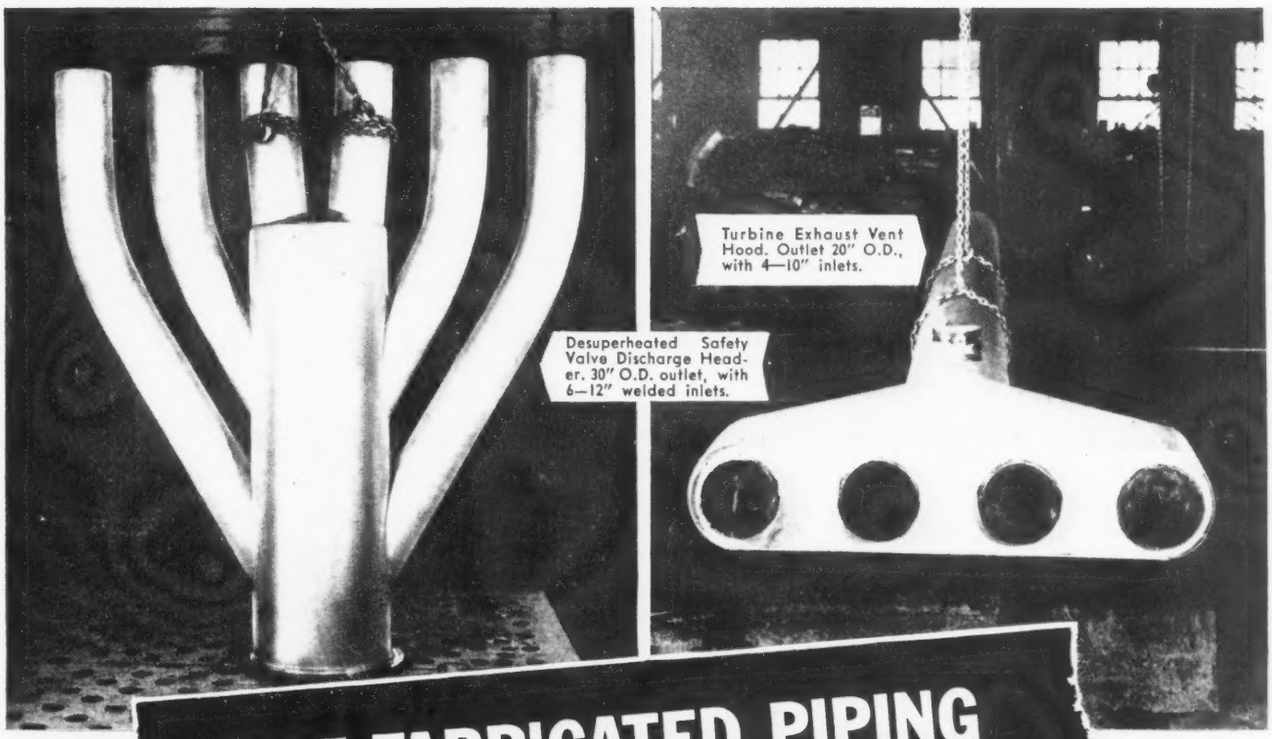


The Genuine Squires Steam Trap



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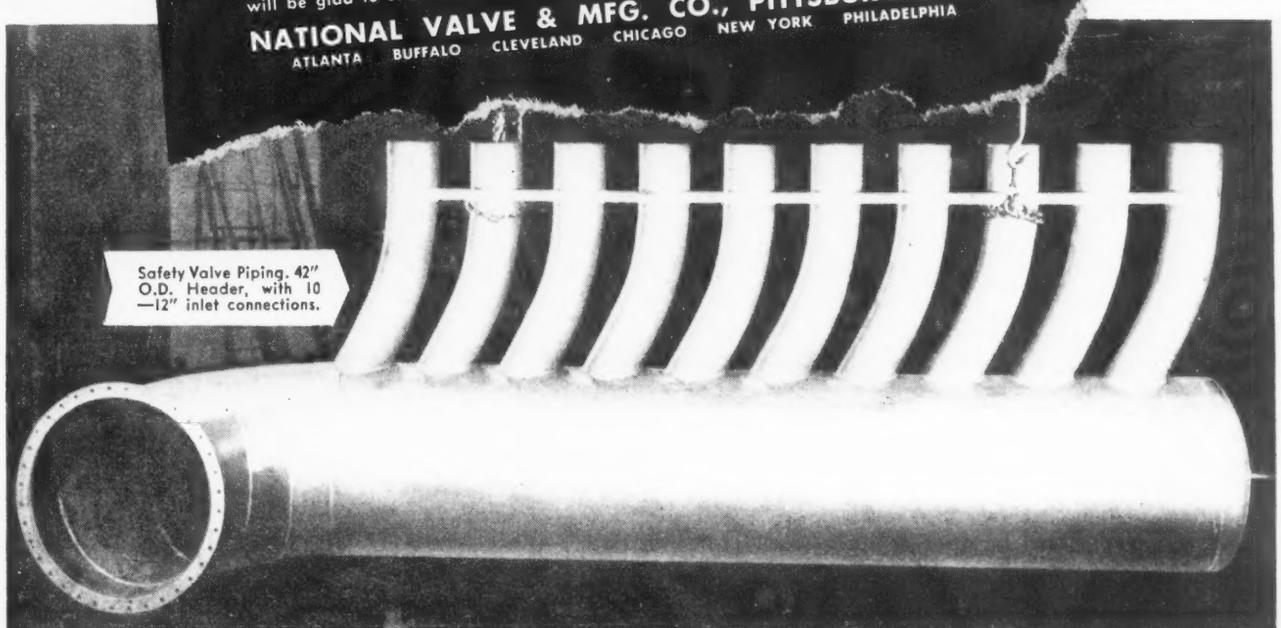

Safety Valve Piping. 42" O.D. Header, with 10 —12" inlet connections.

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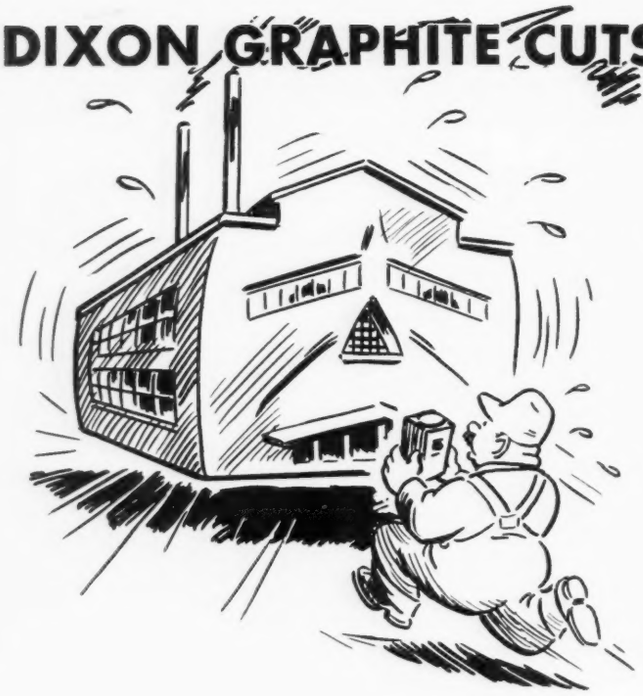

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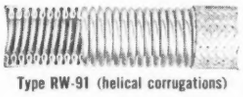

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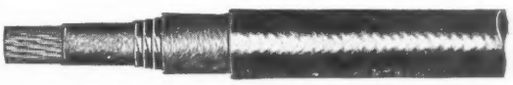

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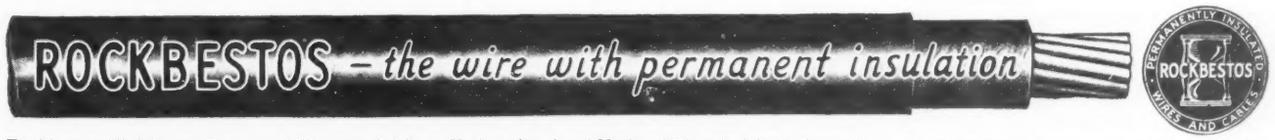

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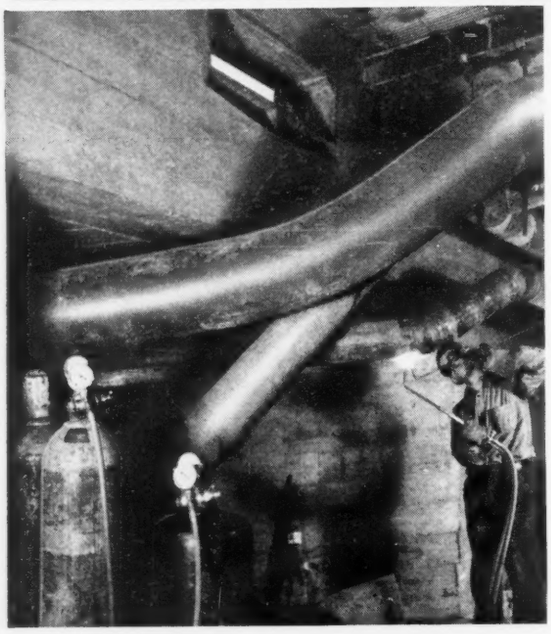

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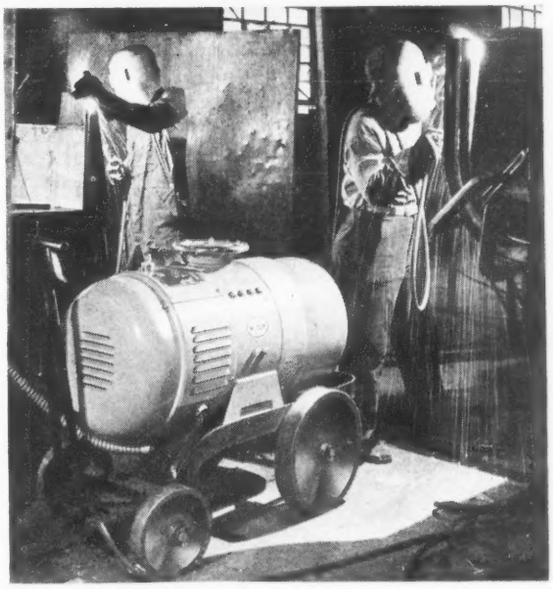

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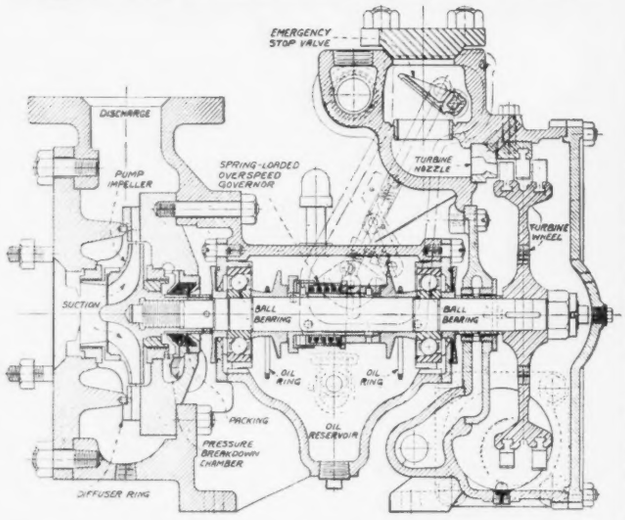

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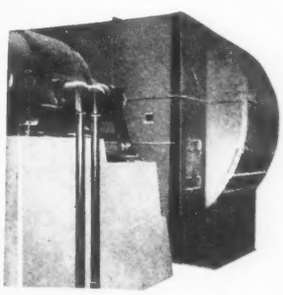

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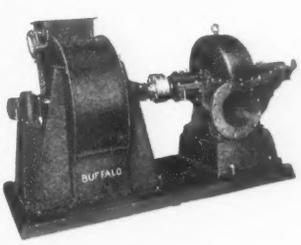

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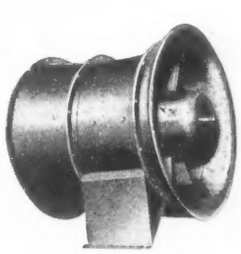

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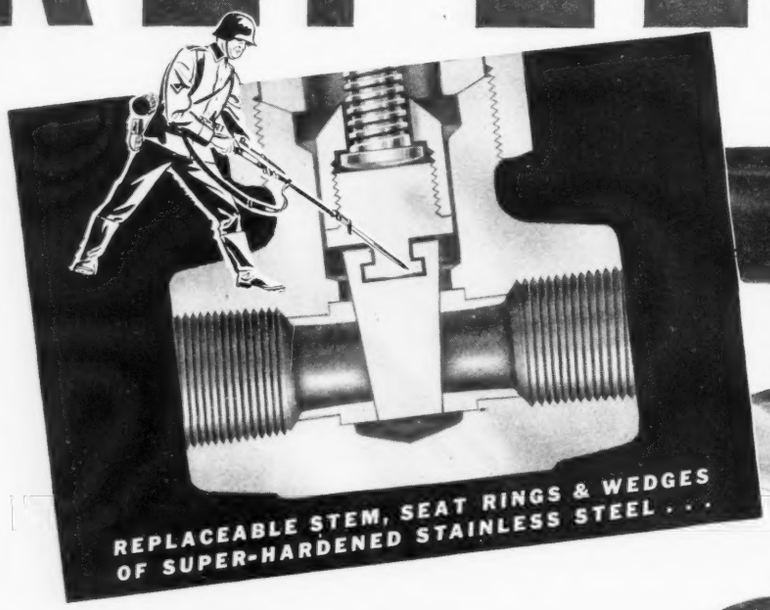

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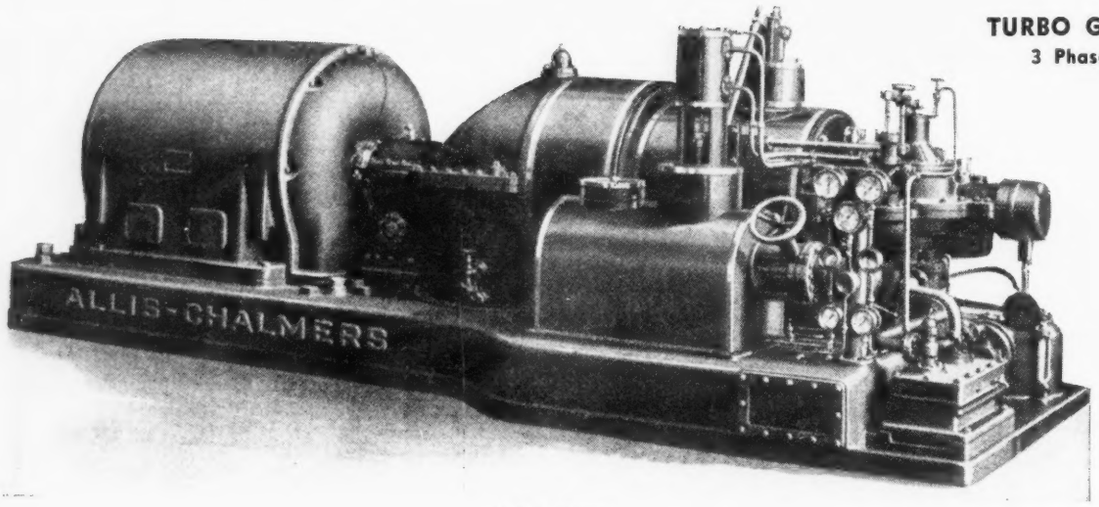
ELECTRICAL POWER



Actual Photograph

1000 KW ALLIS CHALMERS CONDENSING TURBO UNIT

1000 KW 80% P.F. 1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to 1000 KW Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

TURBO GENERATORS

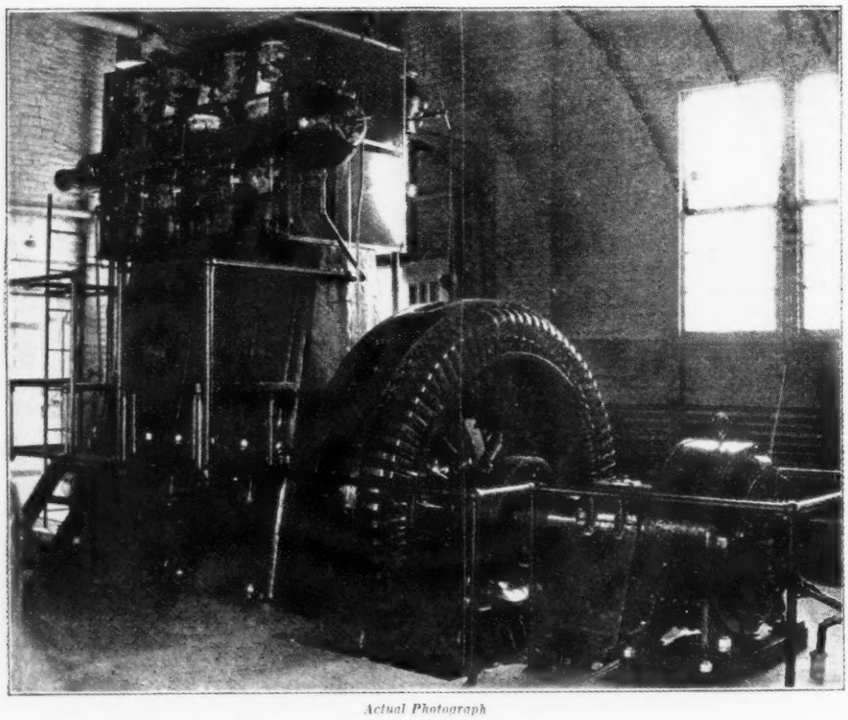
3 Phase 60 Cycle

12,500 KVA GENERAL ELECTRIC, condensing, 150-200 lbs., 500 deg. TT, with surface condenser; 12,000 volts.

5000 KVA WESTINGHOUSE condensing, 150-200 lbs., 500 deg. TT, with surface condenser; 12,000 volts.

2500 KVA WESTINGHOUSE condensing, 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.

1250 KVA ALLIS CHALMERS condensing, 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.



Actual Photograph

625 KVA AMES VERTICAL UNIFLOW UNIT

625 KVA Westinghouse alternating current generator, 3 phase 60 cycle 2300/600/480/240 volts 300 RPM direct connected to 14"x16" Ames 4 cylinder vertical uniflow non-condensing engine, 150-175 lbs. steam pressure 0-5 lbs. back pressure. Complete with exciter and switchboard

Can be shown in operation

ENGINE GENERATORS

3 Phase 60 Cycle

625 KVA WESTINGHOUSE - AMES 4 cylinder vertical Uniflow, 150-175 lbs. 0-5 lbs. back pressure, 2300/600/480/240 volts.

500 KVA GENERAL ELECTRIC-AMES 4 cylinder vertical Uniflow, 150-175 lbs., 0-10 lbs. back pressure, 2300/600/480/240 volts.

438 KVA GENERAL ELECTRIC-SKINNER Uniflow, 150-175 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

210 KVA GENERAL ELECTRIC-AMES Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

210 KVA (2) GENERAL ELECTRIC - SKINNER Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

ENGINE GENERATORS

125/250 Volts 3-Wire D.C.

150 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.

125 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.

THE NATIONAL POWER

VER EQUIPMENT

MOTOR GENERATOR SETS

3 Phase 60 Cycle

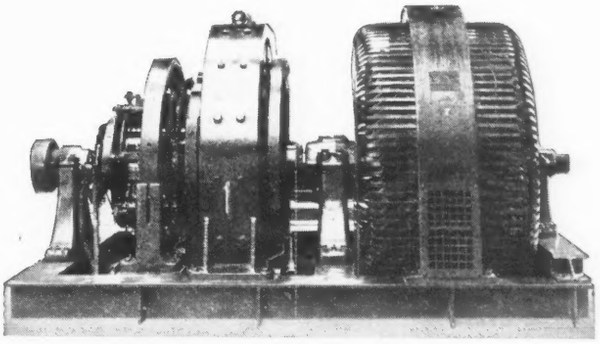
1000 KW GENERAL ELECTRIC synchronous, 125-250 volts 3-wire D.C.; 3 phase 60 cycle 13200 volts A.C., 720 RPM.

1000 KW GENERAL ELECTRIC synchronous, 275 volts D.C., 3 phase 60 cycle 6600 volts A.C., 514 RPM.

750 KW GENERAL ELECTRIC synchronous, 600 volts D.C., 3 phase 60 cycle 4000 volts A.C., 720 RPM.

450 KW GENERAL ELECTRIC 3-unit synchronous, 125-250 volts D.C.; 3 phase 60 cycle 4000/2300 volts A.C., 720 RPM.

170 KW GENERAL ELECTRIC induction, 125 volts D.C., 3 phase 60 cycle 2200/600/440 volts A.C., 1200 RPM.



1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1000 KW GENERAL ELECTRIC direct current generator, 125/250 volts, 3-wire, 720 RPM., direct connected to 1400 HP 80% P.F. General Electric synchronous motor, 3 phase 60 cycle 13200/6600 volts, 720 RPM. Equipped with D.C. breakers. Can be shown in operation.

ROTARY CONVERTERS

60 Cycle

3500 KW (2) WESTINGHOUSE, 225-285 volts D.C., 225 RPM with 3 phase 60 cycle 13200 volt transformers.

2500 KW WESTINGHOUSE, 600 volts D.C., 400 RPM with 3 phase 60 cycle 11000 volt transformer.

1500 KW WESTINGHOUSE, 225-285 volts D.C., 450 RPM with 3 phase 60 cycle 2300/400-6900/12000 volt transformers.

1500 KW (2) WESTINGHOUSE, 600 volts D.C., 720 RPM with 3 phase 60 cycle 33000 volt transformer.

1000 KW (2) WESTINGHOUSE, 600 volts D.C., 900 RPM with 3 phase 60 cycle 12000 volt transformers.

ROTARY CONVERTERS

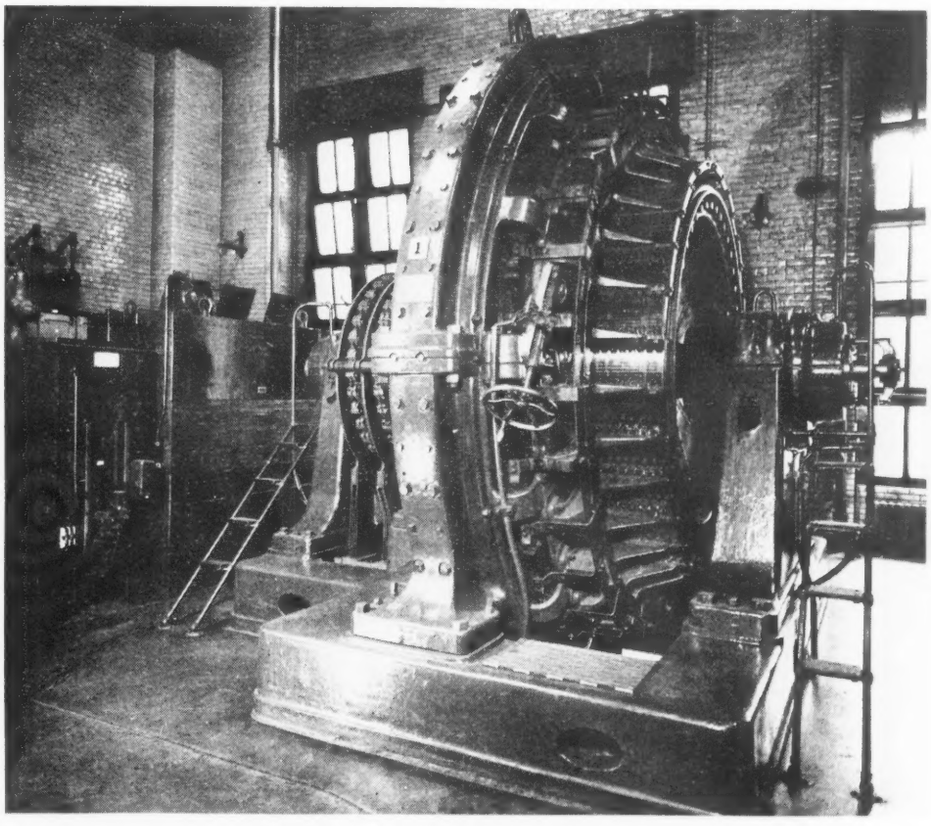
25 Cycle

2000 KW WESTINGHOUSE, 250-300 volts D.C., 300 RPM with 3 phase 25 cycle transformer any voltage.

1500 KW (2) GENERAL ELECTRIC, 600 volts D.C., 300 RPM with 3 phase 25 cycle 11000 volt transformers.

1500 KW (3) WESTINGHOUSE, 600 volts D.C., 250 RPM with 3 phase 25 cycle 6600 volt transformers.

1000 KW GENERAL ELECTRIC, 250 volts D.C., 214 RPM with 3 phase 25 cycle 6600 volt transformer.



Actual Photograph

3500 KW WESTINGHOUSE ROTARY CONVERTER

3500 KW (2) Westinghouse booster type interpole rotary converters, 225-285 volts D.C. 225 RPM; 6 phase 60 cycle A.C. with 3 phase 60 cycle 13200 volt transformer. Complete with control. Can be shown in operation.

MACHINERY CO. 1921 SCRANTON RD. CLEVELAND, OHIO

AVOID DELAY...

Step up your Power thru

MOTOR GENERATOR SETS

1—500 KW, 650 volt, General Electric, synchronous.
1—300 KW, 250 volt, General Electric, synchronous.
1—100 KW, 125 volt, Westinghouse, synchronous.
1—75 KW, 250 volt, synchronous.
2—50 KW, 125 volt, Westinghouse, squirrel cage, with 4000 volt motors.
1—50 KW, 250 volt, General Electric, squirrel cage.
1—50 KW, 125 volt, Westinghouse, squirrel cage.
1—35 KW, 125 volt, Electric Machinery, squirrel cage.
1—25 KW, 125 volt, General Electric, synchronous.
1—20 KW, 125 volt, Burke, squirrel cage.

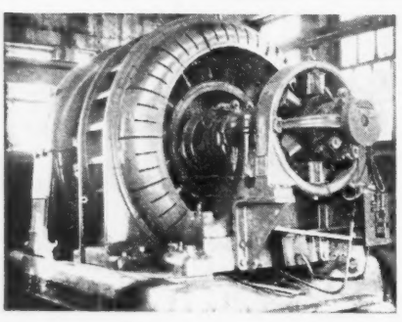
D. C. GENERATORS

1—100 KW, 750 RPM, 125 volt, Western Electric.
1—100 KW, 600 RPM, 125/250 volt, G.E.
1—75 KW, 260 RPM, 250 volt, Westinghouse.
1—67½ KW, 700 RPM, 45 volt, General Electric.
2—32 KW, 650 RPM, 125 volt, Westinghouse.

MOTORS—3 PHASE 60 CYCLE

1—720 HP, 360 RPM, 440 volt, G.E., synchronous.
1—500 HP, 450 RPM, 2200/4000 volt, G.E., slip ring.
1—400 HP, 514 RPM, 440 volt, Westinghouse, slip ring.
1—350 HP, 300 RPM, 440 volt, G.E., slip ring.
1—350 HP, 100 RPM, 220/440 volt, G.E., synchronous.
1—335 HP, 600 RPM, 2300 volt, G.E., synchronous.
1—250 HP, 450 RPM, 220 volt, G.E., slip ring.
1—250 HP, 360 RPM, 440 volt, Westinghouse, squirrel cage.

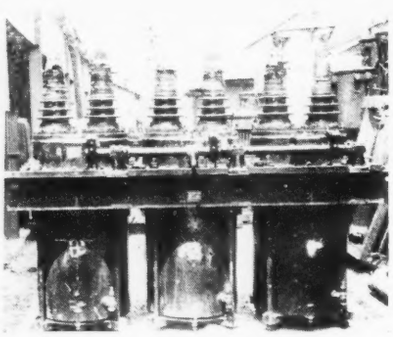
MORE



MOTORS—3 PHASE 60 CYCLE—(Continued)

1—250 HP, 514 RPM, 4000 volt, G.E., synchronous.
1—200 HP, 900 RPM, 440 volt, Westinghouse, slip ring.
1—200 HP, 600 RPM, 2200 volt, G. E., slip ring.
1—200 HP, 450 RPM, 2200/4000 volt, G.E., slip ring.
1—200 HP, 514 RPM, 4000 volt, G.E., synchronous.
1—175 HP, 900 RPM, 440 volt, Westinghouse, synchronous.
1—150 HP, 1800 RPM, 2300 volt, Allis Chalmers, sq. cage.
1—150 HP, 1200 RPM, 4150 volt, Ideal, synchronous.
1—150 HP, 900 RPM, 440 volt, Allis Chalmers, slip ring.
2—150 HP, 720 RPM, 220 volt, Elec. Machinery, synchronous.
1—150 HP, 720 RPM, 440 volt, G. E., slip ring.
1—150 HP, 720 RPM, 2200 volt, G. E., squirrel cage.
1—150 HP, 400 RPM, 440 volt, G.E., squirrel cage.
2—125 HP, 720 RPM, 440 volt, G.E., slip ring.
2—125 HP, 450 RPM, 440 volt, G.E., synchronous.
1—100 HP, 1800 RPM, 440 volt, Allis Chalmers, sq. cage.
1—100 HP, 900 RPM, 220 volt, G.E., squirrel cage.

POWER

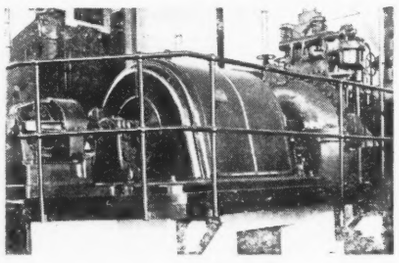


3000 ampere, 15,000 Volts, 3 pole, General Electric type, FK 130 Oil Circuit Breaker

MOTORS—3 PHASE 60 CYCLE—(Continued)

1—100 HP, 900 RPM, 440 volt, G.E., slip ring.
3—100 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G.E., squirrel cage.
1—100 HP, 600 RPM, 440 volt, G.E., slip ring.
1—100 HP, 600 RPM, 440 volt, G.E., squirrel cage.
1—100 HP, 514 RPM, 440 volt, G.E., squirrel cage.
2—100 HP, 450 RPM, 440 volt, G. E., squirrel cage.
1—75 HP, 1800 RPM, 220/440 volt, G. E., squirrel cage.
1—75 HP, 900 RPM, 4000 volt, Elec. Machinery, synchronous.
1—75 HP, 900 RPM, 440 volt, G. E., enclosed, fan cooled, squirrel cage.
1—75 HP, 900 RPM, 220 volt, Fairbanks-Morse, slip ring.
1—75 HP, 900 RPM, 2200 volt, G. E., slip ring.
1—75 HP, 514 RPM, 440 volt, G. E., squirrel cage.

FOR



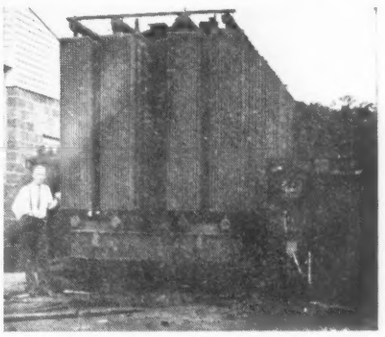
TURBO-GENERATORS

2—1000 KW, 3 ph., 60 cy., 2300/4150 volt, condensing.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—400 KW, General Electric, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, condensing.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, condensing.
1—150 KW, 125/250 volt, Westinghouse, non-condensing.
1—100 KW, 125 volt, Westinghouse, non-condensing.
1—35 KW, 125 volt, G.E., non-condensing.
1—25 KW, 125 volt, Ridgeway, non-condensing.

J. L. HEMPHILL & CO. Inc.

HEMPHILL

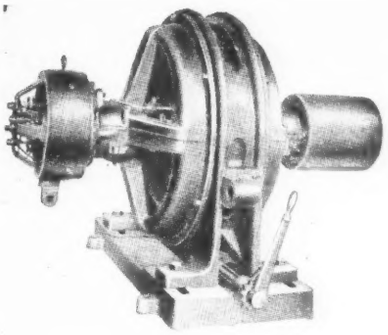
REBUILT EQUIPMENT

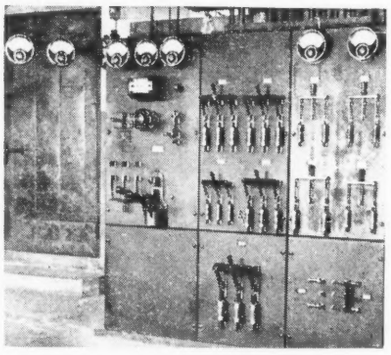


15,000 KVA Allis Chalmers, 3 phase
27,000 to 4000 V.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 235/950 RPM, Burke.
1—60 HP, 600/1200 RPM, General Electric.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—25 HP, 400/1200 RPM, Westinghouse.
1—20 HP, 750/1500 RPM, General Electric.
1—10 HP, 500/1500 RPM, General Electric.
1—5 HP, 600/1200 RPM, General Electric.
6—5 HP, 400/1200 RPM, Westinghouse.
1—5 HP, 225/900 RPM, Electro Dynamic.
1—5 HP, 600/1800 RPM, General Electric.
1—3 HP, 500/2000 RPM, Westinghouse.





Switchboard Panel built by us for Synchronous Motor Generator Set

LESS

ENGINES

2—13x15, Skinner Uniflow, 150/300 RPM.

PUMPS

1—2690 GPM Alberger, turbo-driven, 30' head.
2—2500 GPM Alberger, motor-driven, 24' head.
1—1000 GPM, Cameron, motor driven, 508' head.
2—600 GPM, Worthington, motor driven, 278' head.

TRANSFORMERS

1—15,000 KVA, Pittsburgh, 3 phase, 26,000/4150 volts.
4—833 KVA, Allis Chalmers, 25 cycle, 13,200/440 v.

MONEY

TRANSFORMERS—(Continued)

3—400 KVA, Moloney, 13,800-220/440 volts.
2—400 KVA, G.E., 4156-240/480 volts, Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—300 KVA, Pittsburgh, 4600-115/230 volts.
1—200 KVA, Pittsburgh, 7800-110/220 volts Y.
3—150 KVA, G.E., 33,000-2300/4000 Y.
3—150 KVA, Pittsburgh, 6600/440 volts.
12—150 KVA, G.E., 3 phase, 4150-120/208 volts.
2—150 KVA, G.E., 2400/4800-240/120 volts.
2—150 KVA, G.E., 2400/240 volts, Scott.
1—150 KVA, Westinghouse, 440-220/110 volts.
3—125 KVA, General Electric, 2000/440 volts.
3—100 KVA, Westinghouse, 13200-250 volts.
3—100 KVA, G.E., 2400-240/480 volts.
5—100 KVA, Wagner, 2300/240/120 volts.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—75 KVA, Pittsburgh 2200/115 volts.
3—50 KVA, Wagner, 4150-220 volts.
4—50 KVA, Westinghouse, air cooled, 440-220/220-110 v.
2—50 KVA, Kuhlman, 2300-115/230 volts, Scott taps.
3—50 KVA, Westinghouse, 220-110/220 volts.
3—50 KVA, General Electric, 2200-110/220 volts.
52—37½ KVA, General Electric, 2200-220/110 v.
10—25 KVA, Westinghouse, air cooled, 440/220-110 v.
3—25 KVA, Moloney, 2200-220/110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.
1—15 KVA, GE., 440/110-220 volts.
12—15 KVA, Westinghouse, air cooled, 440/220-220-110 v.
4—10 KVA, G. E., 2300-115/230 volts.
5—7½ KVA, G.E., 440-110/220 volts.

QUICKER

ALTERNATORS

1—625 KVA, 450 RPM, 600 volt, Westinghouse.
1—625 KVA, 3600 RPM, 600 volt, G.E.
1—400 KVA, 400 RPM, 240 volt, Westinghouse.
1—375 KVA, 240 RPM, 2300 volt, Westinghouse.
1—375 KVA, 200 RPM, 240 volt, Elec. Machinery.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chalmers.
1—100 KVA, 1200 RPM, 440 volt, G.E.
1—37½ KVA, 1200 RPM, 2400 volt, Wastinghouse.
1—25 KVA, 1200 RPM, 220 volt, Westinghouse.
1—15 KVA, 1800 RPM, 120 volts, G.E.

OIL CIRCUIT BREAKERS

2—3000 amp., 15,000 volt, 3 pole, G.E., type FK-130.
1—3000 amp., 600 volt, 4 pole, G.E., type FK-24.
2—2000 amp., 15,000 volt, 3 pole, G.E., type FK-53b.
1—1600 amp., 7500 volt, 4 pole, Westinghouse, B-2.
1—1500 amp., 440 volt, 3 pole, Conduit, type D12.
1—1200 amp., 15,000 volt, 4 pole, Westinghouse, B-2.
Also complete stock of small sizes.

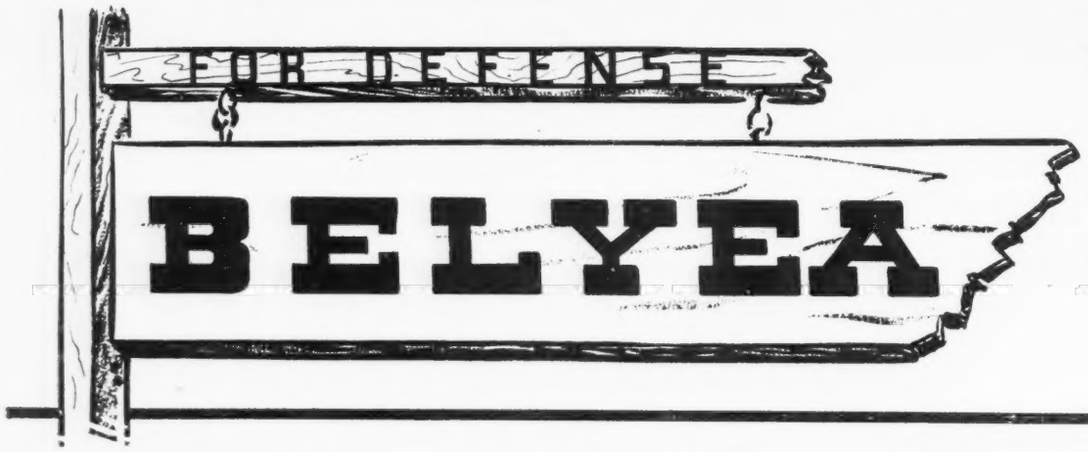
MOTORS—D. C. 230 VOLTS

1—125 HP, 850 RPM, General Electric, type CD.
1—125 HP, 550 RPM, General Electric.
1—100 HP, 1600 RPM, Westinghouse, type SK.
1—75 HP, 850 RPM, Westinghouse, type SK.
1—65 HP, 1000 RPM, General Electric, type RC.
1—50 HP, 1750 RPM, Westinghouse, type SK.
1—50 HP, 1100 RPM, Crocker Wheeler.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, 1100 RPM, G.E. type RC.
1—40 HP, 300 RPM, General Electric.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, 725 RPM, Westinghouse, type SK.

POWER EQUIPMENT

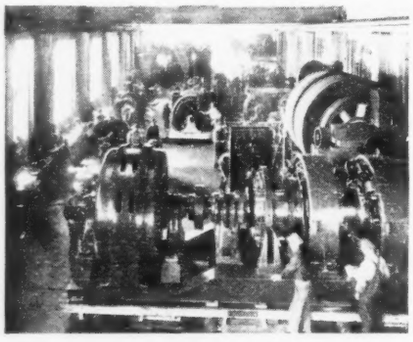
1602 53rd St., NORTH BERGEN, N.J.

Phone: New York LOngacre 5-3227
New Jersey UNion 3-2600

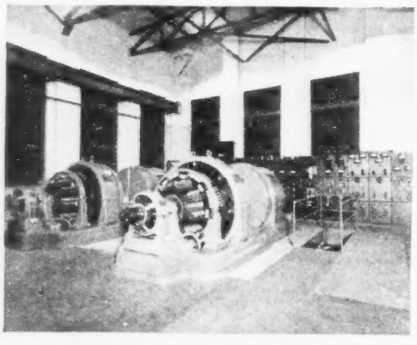


"The

SPEEDY



General View of shop where equipment is RE-NU-BILT. In foreground a 2000 KW—3 unit m g set recently assembled and furnished to a A-1-a Defense Project.



2—1500 KW G.E. motor generator sets 600 V D.C., with 6600 V 3 60 cy syn. motors. Available for prompt shipment

3—1000 Kva G. E. Transformer Units are RE-NU-BILT ready to do their part in National Defense. Duplicate bank in stock

D C MOTORS

230 Volt—Constant Speed

	HP	Make	Type	Speed
1—	300	Cr.Wh.	CCM-108H	550
1—	250	Al.Ch.		525
2—	200	Whse.	SK	400
1—	200	G.E.	DMC	475
1—	150	G.E.	MPC	275
1—	140	G.E.	MDS-108	410
1—	125	G.E.	CDP-123	1750
1—	100	G.E.	CD-123	1150
1—	75	Cr.Wh.	CMC-65H	600
1—	45	Cr.Wh.	65H	400
1—	30	Whse.	SK	850

ADJUSTABLE SPEED

1—	600	Whse.		150/275
1—	300	G.E.	MPC	250/400
2—	275	G.E.	DMC	500/750
1—	200	Whse.		400/500
1—	150	G.E.	MPC	250/450
2—	100	G.E.	CD-123	1150/1450
1—	75	Cr.Wh.	65H	600/1200
1—	75	G.E.	C	500/1000
2—	60	El.Dy.	S	525/1050
1—	50	Whse.	SK	350/1050
1—	50	Rel.	461T	500/1500
1—	30	Whse.	SK	575/1150
1—	25	Cr.Wh.	50H	335/1000
2—	15	Whse.	SK	825/1650
1—	14	El.Dy.	10S	300/1200

D C GENERATORS

	KW	Make	Type	Volts	Speed
1—	1000	Whse.	Engine	500	300
1—	500	Whse.	Engine	250	167
2—	500	G.E.	MPC	600	720
1—	300	G.E.	MPC	550	720
1—	250	Cr.Wh.	CCD	250	600
1—	200	G.E.	ETF	125	1800
1—	200	Al.Ch.		250	580
2—	175	Whse.	SK	250	450
1—	150	Whse.	Engine	550	750
1—	75	Ridg.		250	2000
1—	60	Whse.	SK	125	1150

MOTOR GENERATOR SETS

3 phase—60 cycles

2—1500 KW G.E. 600 v. Gen d.c. to 2100 HP 6600 v. syn. motor
2—1000 KW G.E. 250 v. Gen d.c. to 1400 HP 11000 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 13200 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 2300 v. syn. motor
1—400 KW G.E. 275 v. Gen d.c. to 600 HP 2300 v. syn. motor
2—300 KW G.E. 600 v. Gen d.c. to 435 HP 10000 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 350 HP 4600 v. syn. motor
1—200 KW Ridg. 275 v. Gen d.c. to 300 HP 2300 v. syn. motor
2—200 KW Al. Ch. 3 units: 2—100 KW 250 v., Gen. d.c. to 220 KVA 2200 v. Syn. motor
1—150 KW Ridg. 275 v. Gen d.c. to 230 HP 2300 v. syn. motor
1—125 KW G.E. 250 v. Gen d.c. to 190 HP 2200 v. syn. motor
1—100 KW Whse. 125 v. Gen d.c. to 150 HP 440 v. sq. cg.

MOTOR GENERATOR SETS

3 phase—25 cycle

1—2000 KW Al. Ch. 250 v. Gen d.c. to 2800 HP 6600 v. syn. motor
1—300 KW G.E. 600 v. Gen d.c. to 435 HP 2300 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 390 HP 6600 v. syn. motor

SYN. CONDENSER

1—4000 KVA G.E. 2 unit 3 brg. condenser set with exciter, consisting of
Cond. 4000 KVA ATI 514 RPM 13200 v. 3 ph. 60 cy.
Motor 1150 HP ATI 514 RPM 13200 v. 3 ph. 60 cy.
Exciter 100 KW MPC 514 RPM 125 v. comp. wd.

EVERY MACHINE IN THIS AD IS OWNED OUTRIGHT BY US • • •

RE-NU-BILT SIGN F

BEL

"Buyers' Guide" to . . .

DELIVERY OF RE-NU-BILT EQUIPMENT!

• SUCCESSFUL OPERATION GUARANTEED •

TURBO GENERATOR SET

1—500 KW, Whse., 625 KVA, 480 v., 3 ph., 60 cy. generator with Curtis single stage 160/225 pound non-condensing turbine good for 5 to 10 pounds back pressure

1—500 KW, G.E., 625 KVA, 2300 v., 3 ph., 60 cy. generator with Curtis 4 stage, 150 pound condensing turbine complete with condenser, etc.

ROTARY CONVERTERS

1—300 KW. Al. Ch. Syn. D.C. 250 v., 1200 RPM. with 3—125 KVA transf. 4800/2400 v., 1 ph., 60 cy. and panels.

1—500 KW. G.E. type HCC, 1200 RPM., D.C., 600, V, AC. 6 ph, 60 Cy., 1200 RPM.

TRANSFORMERS

	KVA	Make	Ph.	Type	Voltages
1—	1250	Whse.	3	Auto	4000x2300
4—	1000	G.E.	1	HKDD	13800x2300
3—	333	G.E.	1	HKDD	2300x460
3—	333	Pitts.	1	OISC	13800x440/220
3—	300	G.E.	1	H	132200x2300/575
2—	200	Whse.	1	SK	6900x230/460
3—	200	G.E.	1	HKDD	13800x575
3—	100	Whse.	1	OISC	13200x250
3—	100	G.E.	1	H-KS	2300x230/460
6—	75	G.E.	1	H-KF	2300x230/460
3—	75	Moloney	1	HE	440x110/220

ENGINE GENERATOR SET

1—100 KW. Whse. D. C. Gen. 125/250 v. 3 wire 250 R.P.M. dir. Conn. 150 H. P., 14x15 Skinner steam engine 150# press.

OIL CIRCUIT BREAKERS

1—5000 amp., 600 v., 3 PST GE FK-25 solenoid operated (125 v. DC) all mounted on floor stand frame with tank lifter

1—4000 amp. 600 v. 3 PST GE FK-25 otherwise same as above

1—3000 amp. 600 v. 3 PST GE FK-25 otherwise same as above

A C MOTORS

3 phase—60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	2150	G.E.	ATI	2200	360
1—	2000	G.E.	ATI	2300	450
1—	350	Cr.Wh.	301	2200	600
1—	300	G.E.	ATI	440	600
1—	300	G.E.	ATI	2300	600
1—	200	Whse.		440	514
3—	150	G.E.	TRB	220x440	450
1—	150	Whse.		2200/550	1800
1—	100	Whse.		2200/550	1800
1—	100	Whse.	HP	220	300
1—	100	Whse.	G	2300	900
1—	75	Whse.		440/220	900

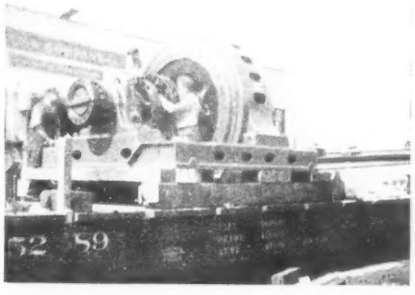
Slip Ring

1—	1000	G.E.	IM	2200	720
1—	800	Whse.	Mill	2200	250
1—	600	Whse.	CW	2200	870
1—	450	Whse.	CW	2200	875
1—	450	G.E.	MTP	2200	1200
1—	400	G.E.	MT	550/440	300
1—	400	Al.Ch.		2300	505
1—	300	Al.Ch.	ANY	2200	585
1—	300	Whse.	CW	2300	1170
2—	300	G.E.	IM	2300	585
1—	250	G.E.	MT	4000/2300	257
1—	250	F.M.	BV	2200	1200
2—	200	Whse.	CW	2200	514
2—	150	G.E.	IM	2200	695
1—	100	G.E.	IM	550	720

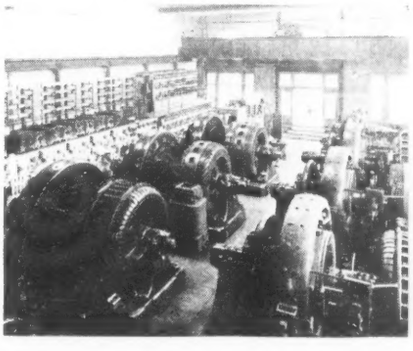
Squirrel Cage

1—	500	G.E.	1-17B	2200	690
1—	400	G.E.	KT	2300	585
1—	300	Whse.	CS	550	580
2—	300	G.E.	IK	2300	600
2—	300	G.E.	IK	440	600
1—	250	Al.Ch.		220/440	1150
1—	200	Whse.	CS	550	720
1—	150	G.E.	IK	2200/440	900
3—	150	Al.Ch.	AN	220/440	1750
3—	100	Whse.	CS	550	1800
1—	75	G.E.	KT	220/440	514
2—	50	Whse.	CS	440	1750
2—	40	Whse.	CS	440/220	870

BELYEA'S office, shop and warehouse recently enlarged to take care of expanding Defense Work



RE-NU-BUILT 800 HP slip ring induction motor being loaded on cars for shipment



Recent puchase of 7—1000 KW G. E. motor generator sets—2 still available for prompt shipment

FIES RELIABILITY

LYEA COMPANY, INC.

Main Office and Shop:

43 HOWELL STREET JERSEY CITY, N. J.

POWER PLANT MACHINERY

Available Immediate Delivery

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

5000 KVA G.E. condensing 200-300 lb. pressure, 575° TT, 2300 volts, 3600 RPM, complete surface condenser with auxiliaries, switchboard and instruments.

4000 KVA ALLIS condensing 200 lb. pressure, 100° superheat, 2300 volts, 3600 RPM, complete with Allis-Chalmers jet condenser with all auxiliaries, switchboard and instruments.

1875 KVA good for 2250 KVA, ALLIS condensing, 200 lb. pressure, 475° TT, 2300 volt, 3600 RPM, complete motor driven exciter set, Westinghouse condenser and all auxiliaries.

1563 KVA WESTGH. condensing 200 lb. pressure, 100° SH, 2400 or 550 volts, 3600 RPM complete condenser and auxiliaries, switchboard and instruments.

937 KVA G.E. automatic extraction condensing, 125 to 200 lbs. pressure, 10 lb. gauge extracting pressure, 2300/480 volts, 3600 RPM, complete condenser, exciter, switchboard and instruments.

937 KVA G.E. condensing 200 lb. pressure, 100° SH, 2300 volts, 3600 RPM complete with Ingersoll-Rand condenser, exciter, switchboard and instruments.

937 KVA ALLIS condensing 200 lb. pressure, 100° SH, 2300-550-480 volts, 3600 RPM complete surface condenser with auxiliaries, direct connected exciter—Modern and practically new.

937 KVA ALLIS condensing 150 to 200 lb. pressure, 475° TT, 2300 volts, 3600 RPM, complete with direct connected exciter, surface condenser and auxiliaries.

750 KVA G.E. condensing, 150-200 lb. pressure, 2300 volts, 3600 RPM, complete surface condenser and exciter set.

375 KVA G.E. condensing 225 lb. pressure, 150° S.H., 2300 volts, 3600 RPM, complete direct connected exciter, Manistee jet condenser with auxiliaries.

112 KVA TERRY-ALLIS CHALMERS noncondensing 175-300 lb. pressure, 0-8 lb. back pressure, 480 volts, 3600 RPM, complete direct connected exciter, switchboard and instruments.

ENGINE-GENERATOR UNITS

3 phase, 60 cycle—Alternating Current

1125 KVA G.E. 480 volts, 150 RPM direct connected 24″x46″x33″ Erie-Ball cross compound engine, complete exciter, and rheostats.

500 KVA G.E., 240/480 volts, 150 RPM direct connected 26″x32″ Skinner Universal Unaflow non-condensing engine, 130-160 lb., 6 lb. back pressure, complete exciter and rheostats.

500 KVA G.E. 240 volts, 120 RPM direct connected 20″x42″ Rice Sargent Corliss non-condensing engine, 125-150 lb., 10 lb. back pressure.

ENGINE-GENERATOR UNITS Continued

438 KVA G.E. 240/480 volts, 150 RPM direct connected 24″x30″ Chuse N.R.C. non-condensing engine, 125-150 lb. pressure, 5 lb. back pressure.

312 KVA ALLIS 240 volts, direct connected Nordberg Unaflow non-condensing engine, 150 lb., 10 lb. back pressure.

125 KVA G.E. 2300 volts, 257 RPM direct connected 14″x16″ Skinner engine, 125-150 lb. complete exciter and rheostats.

Direct Current

1500 KW WESTINGHOUSE 250 volts, 360 RPM generator direct connected by reduction gear to a Westinghouse condensing turbo generator unit complete with auxiliaries.

500 KW CROCKER WHEELER 250 Volts, 300 RPM direct connected Ames vertical Unaflow non-condensing engine, 150-175 lb. pressure, 6 lb. gauge back pressure, complete switchboard and instruments.

300 KW WESTINGHOUSE 250 volts, 175 RPM direct connected 24″x26″ Skinner Unaflow non-condensing engine, 110-150 lb. pressure, 5 lb. back pressure, complete switchboard and instruments.

200 KW G.E., 125 volt, 200 RPM direct connected 18″x24″ Erie Ball non-condensing engine, 135-150 lb. pressure.

100 KW GENERAL ELECTRIC, 125 volts, 250 RPM direct connected Skinner Universal Unaflow non-condensing engine, complete switchboard and instruments.

65 KW GENERAL ELECTRIC 125 volt, 1100 RPM, direct connected Terry noncondensing turbine, 125-150 lb., 5 lb. gauge back pressure.

50 KW WESTINGHOUSE 125 volt, 1750 RPM, direct connected Westinghouse non-condensing turbine, 225 lb. pressure, 150° F-SH, 3 lb. back pressure.

20 KW G.E. 125 volt, 4500 RPM, 175 lb. pressure non-condensing turbine-generator unit.

MOTOR GENERATOR UNITS

1000 KW G.E. 575 volts direct current generator direct connected 1430 HP, 3 phase, 60 cycle, 4000 volt, 514 RPM synchronous motor.

20 KW G.E. 125 volts direct current generator direct connected 25 HP, 3 phase, 60 cycle, 220 volts, 1200 RPM motor.

MOTORS

3 phase, 60 cycle

800 HP, WESTGH. 440 V., 240 RPM synchronous.

400 HP, WESTINGHOUSE type CW, 550 V., 400 RPM slip ring.

400 HP, G.E. type TS, type TS, 440 V., 300 RPM synchronous.

400 HP, WESTINGHOUSE type CW, 440 V., 500 RPM, slip ring.

300 HP, 80% P.F. WESTINGHOUSE 2300 V., 200 RPM synchronous.

250 HP, ALLIS-CHALMERS 440 V., 600 RPM synchronous.

125 HP, (3) 80% P.F. Elec. Mchy. 440 V., 400 RPM synchronous with starting equipment.

125 HP, 80% P.F. Elec. Mchy. 440 V., 514 RPM synchronous.

75 HP, E.M. CO. 2300 V., 1200 RPM slip ring.

50 HP, (2) G.E. form K, 220 V., 900 RPM squirrel cage.

22 HP, G.E. type ITC, 440 V., 1200/600 RPM, slip ring.

MISCELLANEOUS

1 WESTINGHOUSE frequency changer set consisting of a 655 HP, 3 phase, 25 cycle, 2200 volt, 300 RPM synchronous motor direct connected to 565 KVA 80% P.F., 3 phase, 60 cycle, 240 volt alternating current generator complete and equipped with direct connected exciters, all panels with instruments—practically new.

250 KW CROCKER-WHEELER 250 volt, 600 RPM compound wound interpole direct current generator.

6250 KVA, form VD, 2300 volt, 60 cycle G.E. phase changer—practically new.

450 KVA, 3 phase, 60 cycle, 2300/4000 volt primary, 230/460 volts secondary General Electric transformer.

1500 KVA, 3 phase, 60 cycle, 22,000 volt primary, 2300 volt secondary WESTINGHOUSE transformer.

900 KW G.E. 3 phase, 60 cycle, 480 volt, 150 RPM alternating current generator with exciter.

500 KVA IDEAL, 3 phase, 60 cycle, 240 volts, 400 RPM, three-bearing belted type generator with direct connected exciter andrheostats.

312 KVA WESTINGHOUSE, 3 phase, 60 cycle, 2300 or 220 volts, 200 RPM, enggine type generator with belt driven exciter and rheostats.

200 KVA WESTINGHOUSE, 3 phase, 60 cycle, 240 volts, 200 RPM engine type generator with rheostat.

150 KVA G.E. 3 phase, 60 cycle, 440 volt, 900 RPM belted alternator.

1 ELLIOTT EHRHART jet condenser with all auxiliaries suiitable for operation with a 5000 KW turbine-generator unit.

1500 sq. ft. WESTINGHOUSE surface condenser.

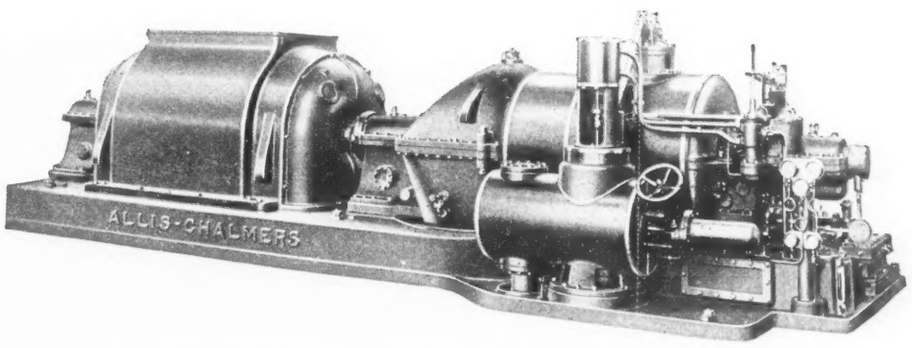
1055 cubic feet, 100 lb. air pressure CHICAGO PNEUMATIC horizontal compresor direct connected to 170 HP, 240 V., 150 RPM General Electric direct current motor.

Utilities Electrical Machinery Corporation
600 NATIONAL CITY BANK BLDG. CLEVELAND, OHIO
WIRE OR PHONE LONG DISTANCE 422

DEPENDABLE

Turbo-Generators

It is the Practice of this Company to Confine its Inventory Strictly to Comparatively Modern, Little Used Turbines Some Are Practically New



2—4000-KVA, Allis-Chalmers, Condensing, 3/60/2300-v, 150/200#, 500°-F, TT.

PART OF OUR INVENTORY—BELOW

1—G.E., 5000-KVA, 3/60/2300-v, 250#, 550°-F, Condensing.

2—Allis-Chalmers 4000-KVA, 3/60/2300-v, 200#, 500°-F, TT, Condensing.

1—Westinghouse 3750-KVA, 3/60/480 volts, 150#, 100 SH°, Condensing, Surface Condenser.

1—G.E., 2500-KVA, 3/60/2300-v, 250#, 550°-F, 4-Stage Condensing.

1—G.E., 1875-KVA, 3/60/480-volts. Condensing.

1—Allis-Chalmers 1875-KVA, 3/60/2300-v. 200#, 500°-TT, Condensing.

1—Westinghouse, 1563 KVA, 3/60/2400 volts, 200#, 100° SH. Condensing, Modern.

1—G.E., 1250-KVA, 3/60/2300-v, 250#, 550°-TT, 19-Stage, High Economy, Surface Condenser.

1—G.E., 1250-KVA, 3/60/480-v, 175#-P and 16# Abso. Mixed Pressure.

1—G.E., 937-KVA, 3/60/2300-v, 200#, 500°-TT: 15# Extraction Pressure.

1—G.E., 937-KVA, 3/60/2300-v, 200#, 500°-TT, 3-Stage Condensing.

1—Allis-Chalmers, 937-KVA, 3/60/2300-v, 200#, 500°-TT, Condensing Surface Condenser.

1—G.E., 625-KVA, 3/60/2300-v, 200#, 500°TT. Condensing.

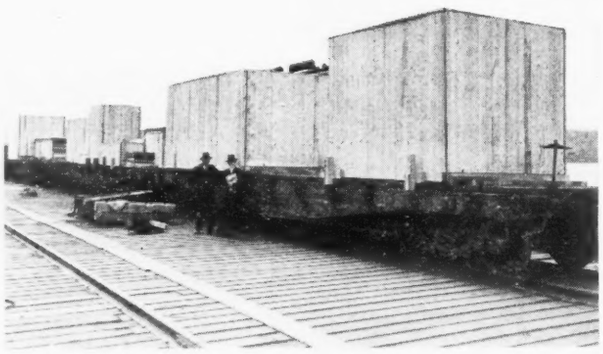
1—G.E., 625-KVA, 3/60/600-v, 250#, 550°F-TT, Condensing Modern.

WILMS, WEAVER & CO. Union Guardian Bldg. DETROIT, MICH.

We Deal in Turbo-Generators Exclusively

Brew-Woltman offers

POWER PLANT EQUIPMENT



Export shipment 6000 KW turbo unit

SPECIAL

2—282 HP, Edge Moor, cross drum, ASME water tube boilers, 200-lbs. W.P., 500° T.T., Coxe traveling grate stokers, Diamond soot blowers, Foster superheaters, Hagen combustion control, flow meters and regular fittings.

TURBO UNITS-60 Cy.

1—12500 KVA Westinghouse Cond.
1— 9375 KVA General Electric Cond.
1— 7500 KVA General Electric Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA Allis Chalmers Cond.
1— 3750 KVA Westinghouse Cond.
1— 3125 KVA Allis Chalmers Cond.
1— 2500 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA Terry Double Extraction.
3— 625 KVA General Electric Cond.
1— 625 KVA General Electric Extr.
1— 375 KVA General Electric Cond.
1— 250 KVA General Electric Cond.
2— 375 KVA General Electric Non-C.
1— 312 KVA Moore Non-Condensing
2— 156 KVA Allis Chalmers Non-C.
1— 125 KVA Westinghouse Non-C.

D.C. TURBO UNITS

1—1500 KW Westinghouse 250 V.
1— 600 KW Terry Double Extr. 125 V.
1— 500 KW Westinghouse 250 V.
1— 200 KW General Electric 250 V.
1— 50 KW General Electric 125 V.
1— 35 KW General Electric 125 V.
1— 25 KW General Electric 125 V.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1—1000 KVA Skinner Uniflow
2— 937 KVA Nordberg Uniflow
1— 500 KVA Rice & Sargent Corliss
1— 425 KVA Hamilton Poppet Valve
1— 325 KVA Skinner Uniflow
1— 312 KVA Fitchburg 4-valve
1— 250 KVA Skinner Uniflow
1— 240 KVA Hamilton Corliss
1— 150 KVA Hamilton Poppet Valve

DC STEAM ENGINE UNITS

1—500 KW Skinner Uniflow 250 V.
1—400 KW Mesta Uniflow 250 V.
1—300 KW Skinner Uniflow 250 V.
1—300 KW Chuse 4-valve 250 V.
2—250 KW Skinner Uniflow 250 V.
1—200 KW Chuse 4-valve 250 V.
2—150 KW Erie Ball 4-valve 250 V.
1—150 KW Ames Uniflow 125/250 V. 3-wire
1—125 KW Ames Uniflow 125/250 V. 3-wire
1— 75 KW Uniflow 250 V.
1— 50 KW Ames Uniflow 125/250 V. 3-wire

OIL AND GAS ENGINE UNITS—60 Cy.

1—1750 KVA Mesta (gas) 2300 V.
2—1000 KVA Mesta (gas) 2300 V.
1—1000 KVA Nelseco 2300 V.
1— 700 KVA McIntosh-Sey. 2300 V.
1— 603 KVA Fair.-Morse 480 V.
1— 375 KVA Ing.-Rand 2300/440/220 V.
1— 375 KVA Cooper-Bessemer 2300 V.
1— 237 KVA Fair.-Morse 480 V.
1— 210 KVA Nat'l Superior 440/220 V.
1— 200 KVA Fair.-Morse 2400/440/220 V.
1— 100 KVA Buckeye 240/480 V.

WATER TUBE BOILERS

2—750 HP Badenhausen 200-lb. Stokers
5—525 HP Springfield 200-lb. Stokers
2—520 HP Heine 200-lb. Hand Fired
2—511 HP Union 200-lb.
2—500 HP Heine 200-lb.
1—484 HP Springfield 225-lb. Stoker
1—468 HP Keeler Type C-P 250-lb.
2—407 HP Erie City 250-lb. Stokers
2—389 HP Stirling 200-lb. Stokers
1—375 HP B. & W. 200-lb. Stoker
2—357 HP Casey-Hedges 175-lb. Stokers
1—353 HP Edge Moor 200-lb.
1—325 HP Stirling 160-lb. Stoker
2—282 HP Edge Moor 200-lb.
2—254 HP Stirling 180-lb. Stokers
2—160 HP Stirling 155-lb. Hand Fired

SYNCHRONOUS MOTORS—60 Cy.

2—800 HP Electric Machy. 6600 V. 450 RPM
1—600 HP General Electric 2300 V. 1800 RPM
1—400 HP Westinghouse 440 V. 277 RPM
1—340 HP Westinghouse 440 V. 300 RPM
1—275 HP General Electric 440 V. 600 RPM.

MOTOR GENERATOR SETS—60 Cy.

2—1500 KW General Electric 600 V.
2— 500 KW General Electric 600 V.
1— 300 KW General Electric 600 V.
1— 300 KW General Electric 275 V.
1— 75 KW General Electric 125 V.

AIR COMPRESSORS

1—2100 Ft. 65-lb. Worth. 60 cy. motor
1—1750 Ft. 100-lb. Ing. PRE-2, 60 cy. motor
2—1574 Ft. 100-lb. Sul. WN32, 60 cy. motor
1—1300 Ft. 100-lb. Ing. PRE-2, 60 cy. motor
1—1300 Ft. 100-lb. Sul. Diesel
1—1051 Ft. 100-lb. Sul. WN32, 60 cy. motor
2— 600 Ft. 100-lb. Ing. POC2, Diesel

The Above Is Only a Partial List

ROTARY CONVERTERS—60 Cy.

2—1000 KW General Electric 600 V.
1— 750 KW General Electric 250 V.
1— 500 KW General Electric 250 V.
1— 500 KW General Electric 600 V.
2— 300 KW General Electric 600 V.

FREQUENCY CHANGERS

2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA West. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1500 KW G. E. 25 60 cy. 300 RPM
1—1250 KVA West. 25/62½ cy. 375 RPM
1—1000 KVA G. E. 60/25 cy. 514 RPM
2— 750 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA G. E. 25/60 cy. 300 RPM

TRANSFORMERS—1 ph. 60 C.

3— 600 KVA West. 120,000/2300 V.
3— 1667 KVA G. E. 66000/22000 V.
1— 1500 KVA Pitts. 66000/33000 V. 3 ph.
3— 750 KVA Pitts. 66000-22000/33000 V.
3— 333 KVA Pitts. 44000/2300 V.
3— 1000 KVA Wagner 33000/2300 V.
3— 500 KVA Allis 33000/480 V.
2— 1000 KVA G. E. 23000-11500/575 V.
3— 100 KVA G. E. 22000/6900 V.
2—10000 KVA Pitts. 13200/4600 V. 3 ph.
1— 450 KVA G. E. 13200/240-480 V. 3 ph.
4— 200 KVA West. 13200/2300-4000 V.
3— 150 KVA Pitts. 13800/230-460 V.
3— 75 KVA West. 13800/230-460 V.
3— 150 KVA Pitts. 11000/2400 V.
3— 100 KVA West. 11000/250-125 V.
2— 75 KVA G. E. 11000-9900/244-488 V.
2— 3300 KVA G. E. 6600/110 V. 3 ph. Furnace
3— 1250 KVA G. E. 6600/550 V.
3— 100 KVA G. E. 6900/440-220 V.
3— 833 KVA Penn. 4800/120-240 V.
3— 1500 KVA West. 2300/106 V. 3 ph. Furnace
3— 1000 KVA Pitts. 2300-4600/550 V.
3— 75 KVA Wagner 2300/230-460 V.
3— 50 KVA Wagner 2400/480-240 V.
6— 50 KVA G. E. 2400/240-120 V.

SYN. CONDENSERS

1—4000 KVA G. E. 13200 V. 514 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1—1000 KVA G. E. 2300 V. 900 RPM
1— 500 KVVA West. 2200 V. 900 RPM

OIL CIRCUIT BREAKERS

1—800 A. 87 KV Am. Br. Bov. AF 22 Outdr.
2—600 A. 37 KV Condit F040-37 Outdoor
5—600 A. 30 KV Kelman CB-76 Outdoor
1—400 A. 25 KV G. E. FK0136 Outdoor

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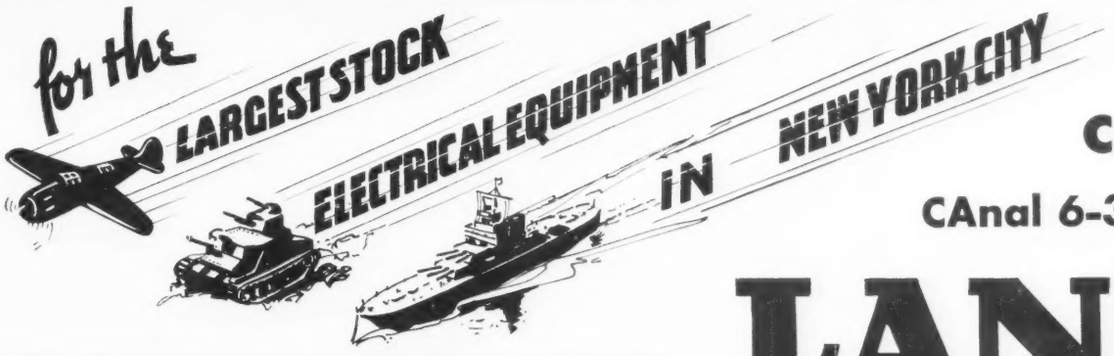

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SYNCH. MOTORS

200 H.P. G.E. TS 514 RPM
100 H.P. Westinghouse 900 RPM
50 H.P. Elec. Mchy. 1200 RPM
47 H.P. Westinghouse 1200 .75 PF.

SLIPRING MOTORS

300 H.P. General Electric 720 RPM
200 H.P. General Electric 514 RPM
112 H.P. G.E. hoist 720 RPM
100 H.P. Fairbanks Morse 720 RPM
100 H.P. Westinghouse 720 RPM
75 H.P. Westinghouse 1200 RPM
60 H.P. Westinghouse 1200 RPM
60 H.P. General Electric 1200 RPM
60 H.P. General Electric 900 RPM
60 H.P. Westinghouse 300 RPM

SQUIRREL CAGE MOTORS

200 H.P. Allis Chal. 1800 RPM
200 H.P. General Electric 600 RPM
150 H.P. General Electric 1200 RPM
125 H.P. Allis Chalmers 1200 RPM
100 H.P. General Electric 1200 RPM (2)
100 H.P. General Electric 900 RPM
75 H.P. Westinghouse 1800 RPM
75 H.P. Westinghouse 900 RPM
75 H.P. General Electric 900 RPM
60 H.P. Westinghouse 1200 RPM

A.C. GENERATORS

200 K.W. General Electric 600 RPM
100 KVA Crocker Wheeler 900 RPM
100 KVA Elec. Machy. 1200 RPM
90 K.W. General Electric 900 RPM
75 KVA General Electric 1200 RPM
56 KVA General Electric 1200 RPM
40 KVA Crocker Wheeler 1200 RPM
15, 20, & 25 KVA 1200 RPM (8)

LOW & HIGH VOLT. GEN.

200 K.W. West. 600 V. Mtr. Gen. Set
800 amp. 10-50 Volts General Electric
2 to 40 K.W. 600 to 2000 V. M.G. Sets (11)
24 K.W. 60 V. General Electric
1 to 75 K.W. 10 to 80 V. (15)

D.C. EQUIPMENT

230 V.D.C. MOTOR GEN. SETS

100 K.W. Westinghouse 1200 RPM
75 K.W. Elec. Mchy. 1200 RPM
50 K.W. Burke 1200 RPM
45 K.W. Westinghouse 700 RPM

125 V. M.G. SETS

100 K.W. General Electric
75 K.W. General Electric
60 K.W. Westinghouse Syn. mtr.
50 K.W. Crocker Wheeler
35 K.W. Elec. Mchy. Synch.
25 K.W. General Electric

230 V. D.C. MOTORS

165 H.P. Crocker Wheeler 670 RPM
75 H.P. General Electric 850 RPM
60 H.P. Sprague 900 RPM
60 H.P. General Electric 1000 RPM
60 H.P. Roth 600 RPM
50 H.P. General Electric 850 RPM
40 H.P. Reliance 625 RPM

230 V. VAR. SPEED MTR.

100 H.P. Crocker Wheeler 550/900 RPM
75 H.P. Electro Dyn 700/1050 RPM
75 H.P. General Electric 1000/1500 RPM
50 H.P. General Electric 500/1500 RPM
30 H.P. General Electric 825/2000 RPM
25 H.P. General Electric CD 575/1300 RPM
15 H.P. G. E. RF 400/1200 RPM
15 H.P. Westinghouse 825/1650 RPM
15 H.P. General Electric 600/1800 RPM
15 H.P. Electro Dyn. 450/1350 RPM

115 VOLT D.C. MOTORS

160 H.P. Westinghouse SK 900 RPM
90 H.P. General Electric 900 RPM
15 H.P. Eck 1500/1800 RPM
10 H.P. General Electric 850 RPM

ANODIC TREATING GENERATORS

3—1600 Amp. General Electric, Syn. 3 unit Motor Generator Sets, 10 to 50 Volts—complete.

In Stock for Immediate delivery

Motor Driven Electric ARC Welders — Portable and Stationary — 150 Amp. to 600 Amp.

MISCELLANEOUS

12½ x 12, 390' American Air Compressor
14 x 12 Ingersoll Rand Air Compressor
1 Ton Shepard

15 to 50 K.W. Frequency Changers 90, 100, 120 cycle (7)
5 H.P. B & D D.C. Buffer Fans & Blowers (19)
Tirrell Voltage Regulators
6—200 KVA GE Transformers 13200/2300/4000
165 KVA Arc Furnace Transformers

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AC or DC Motors
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Panelboards
Frequency Changers
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We are very actively in the market at the present time for Motor Generator sets from 5 KW to 500 KW—What Have You To Offer?

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1—*Modern* **Rebuilding** *in a Modern Plant*

2— **Advisory** *Engineering Staff*

3—*An* **IRONCLAD** *Guarantee*

MOTORS · TRANSFORMERS · GENERATORS

Slip Ring Motors 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
700	2200	G.E.	900
500	2200	Whse.	450
300	2300–4000	G.E.	1200
300	440	G.E.	1800
200	2200–550	G.E.	1800
200	220–440	G.E.	1800
150	2200	G.E. MT (New)	1800
150	2200–440	Whse.	1800
150	220–440	G.E. MT (New)	1800
150	440–220	G.E.	600
150	2200	G.E.	900
100	550	G.E.	900
100	440–220	G.E.	600
100	550–220	G.E.	720
100	220–440	G.E. MTC	900
100	550	G.E.	720
80	220–440	G.E. MTC	900
75	440–220	G.E.	600
75	440–220	G.E.	900
75	550	G.E.	900
60	2200	G.E.	720
60	550	G.E.	900
60	220–440	G.E. MTC	900
60	220–440	G.E.	900
60	220–440	G.E.	720
50	440–220	G.E.	900
50	2200	G.E.	1800
50	550	G.E.	900
40	550	G.E.	900
40	220–440	G.E.	1200
40	2200	G.E.	900
30	220/440	G.E. MTC	900

Squirrel Cage Motors

500	220/440	G.E.	IK	900
500	220/440	G.E.	IK	1200
400	2200	Whse.		1800
300	2200/440	G.E.		1200
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IK	600
230	440/220	G.E.	IK	720
200	440/220	G.E.	IK	720
150	2200/550	Al. Chal.		450
100	550/220	G.E.		720
100	2200	G.E.	IE-K	1800
100	440/220	G.E.	KT	720
75	220/440	G.E.	IK	900
75	2200	G.E.		1200
75	2200/550	G.E.		900
75	2200	G.E.	IK	1800
60	220/440	G.E.	KT	900
50	220/440	G.E.	K	1800
50	220/440	G.E.	KT	900
50	550	G.E.	KT	1800
50	220/440	G.E.	KT	1200
50	220/440	G.E. fan cooled new		1200
40	220/440	G.E.	KT	1200
30	2200	G.E.		1200

Synchronous Motors 3 Ph., 60 Cy.

H.P.	Volts	Make	Speed
400	440–220	Whse.	276
360	440–220	G.E.	200
240	2300–550	G.E.	900
240	2200–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
125	2300	G.E.	257
125	220–440	G.E.	300
60	220/440	G.E.	300
50	220–440	G.E.	1200

A.C. Generators

312 KVA, 900 rpm—2200/550 V. Whse.
225 KVA, 600 rpm—2200/480-240 V. G. E.
225 KVA, 900 rpm—2200-550 V. G.E.
187 KVA, 900 rpm—2300-550 V. Whse.
150 KVA, 900 rpm—600 V. G.E.

Transformers—60 Cy.

3—667 KVA, Whse., 22000-2400.
1—500 KVA Packard 4600/4160-2300 volt, 3 phase auto.
3—350 KVA, G.E., H-KD 13200/6600-4600.
3—250 KVA, Pittsburgh, 13,200-2200 volt.
3—250 KVA., G. E., H-KD 23000-2300.
3—200 KVA G.E., H-KD, 13200/2300/4000Y.
3—200 KVA G.E., H-KD 13800-230/460.
3—200 KVA G.E., H-KDD 13200/6600-2300/4600.
1—150 KVA, G.E., HTQ auto. 220 volt, 3 ph., 220 volt, 2 ph. 3-wire.
3—150 KVA Moloney 4000-230/460.
3—100 KVA G.E., H-KDD 6600/11430Y-2300, 25 cy.
3—100 KVA, Whse., 13200-125/250.
3—100 KVA Whse. SK, 2300-230/115.
3—100 KVA, Whse. 22,000-2300 volt.
6—100 KVA, G.E., H-KDD 6900/11950Y—230/115 volt.
3— 75 KVA, G.E., H-KS 2300-230/115.
3— 50 KVA, Pittsburgh OISC, 13800-240/120.
3— 50 KVA, Whse. SK, 22000/11000-2300.
3— 50 KVA, Moloney 2300-230/115.
3— 50 KVA, G.E., H-KS 2300/230/460.
6— 50 KVA, G.E., H-KS 2300-230/115.
3— 50 KVA, Whse., SK, 13800-240/120.
3— 37½ KVA, G.E., H-K 2300-230/115.
3— 37½ KVA, G.E., H-K, 2200-460.
2—37½ KVA Pittsburgh, 2400-120-240.
3— 25 KVA G.E., H-KR, 6900-230/460.
3— 25 KVA, Whse., S, 2300-575.
3— 25 KVA, G.E., H-K, 2300-230/460.
1— 25 KVA, Whse., type S, 4800/4150/3600/2400-120/240 V.
3— 15 KVA, G.E., H-N, 2300-230/115.
3—7½ KVA, G.E., H-N, 2300-230/120.

Motor Generator Sets

1—100 KW 250/125 V. 3 wire, 1200 RPM, G.E., type RC, Conn. to IEK 150 HP, 440/220 V. 3 phase, 60 cycle SC motor.
1—100 KW, 250 volt, 1200 RPM Ridgeway, compound wound, conn. to 150 HP, 2300/440 volt, 3 ph., 60 cy. synch. motor.
1—35 KW, 125 V. 1200 RPM, G.E., type RC, compound wound, conn. to KT 50 HP 220/440 Volt, 3 phase, 60 cycle motor.
1—G.E. 3-unit set, consisting of 1 type RC, 10 KW, 220 volt, 1750 rpm, and 1 RC, 10 KW, 125 volt generator coupled to KT 35 HP 220/440 V., 3 ph., 60 cy. SC motor.

Turbo Generator Sets

2—1000 KW 2300 Volt, 3 phase, 60 cycle, 3600 RPM G.E. condensing.

Engine Generator Sets—Steam

1—300 KW, 200 RPM, 250 V. G.E. type MPC compound wound interpole generator connected to 23"x25" 125/150 lb. Harrisburg Uniflow Engine.
1—75 KW, 300 RPM, 250/125 volt, 3 wire Whse. conn. to Ball slide valve engine.
1—25 KW, 300 RPM, 250/125 volt, 3 wire Whse., conn. to Ball slide valve engine.

Diesel Engines

1—75 HP Worthington 450 RPM 4 cylinder 2 cycle engine.

D.C. Generators

KW	Volts	Make	Type	Speed
200	250	G.E.	CLC	500
75	125	Whse.	SK	1150
75	250	Crocker-Wh.	H	1800
50	250	Crocker-Wh.	H	850
25	250	G.E.	RC	1700

INSTRUMENT TRANSFORMERS;

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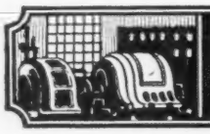

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NEED power equipment? If you do, it will pay to investigate the unusual service offered by Chicago Electric Company. Organized over a quarter century ago to serve industry, Chicago Electric have supplied the nation's leading industrial organizations with guaranteed rebuilt power equipment to fill their every need . . . You run no risk because every unit is guaranteed to perform "same as new". Equally important you deal with an organization which boasts some of the nation's finest installations—installations handled complete from Engineering through completion. Ask us for our solution to your power equipment problem and let us furnish you with concrete evidence of our working ability. You'll find that we can save you up to 50% the price of similar equipment now and what's more give you IMMEDIATE DELIVERY.

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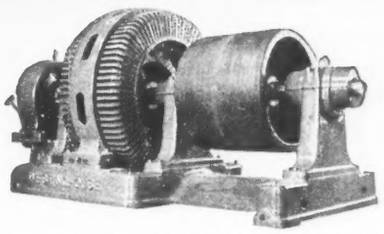
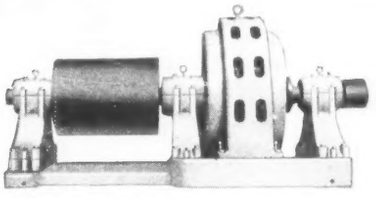
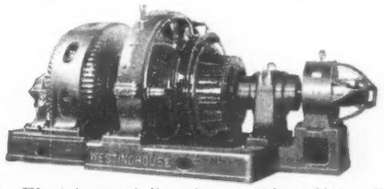


350 KVA Alternator shipped from Chicago Electric shops for service in a large paper mill. The buyers saved over 50% the cost of similar equipment new.



750 KPA Crocker-Wheeler Alternator installed for use in a large lumber mill . . . No matter what type of equipment you need you'll find it in our large stock.



Chicago Electric specializes in rebuilding Motor Generator Sets. This 750 KW Westinghouse set and a twin unit were furnished to a large Ohio manufacturing plant. Notice the stock of M.G. Sets in the picture above.

CHICAGO ELECTRIC COMPANY

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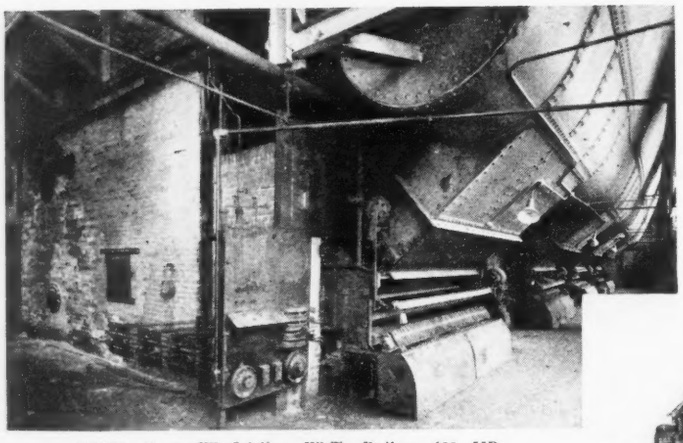
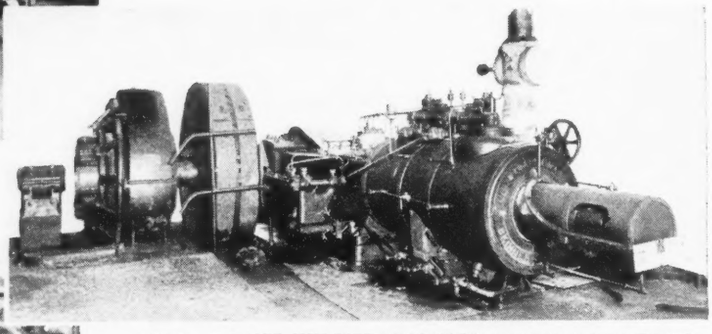
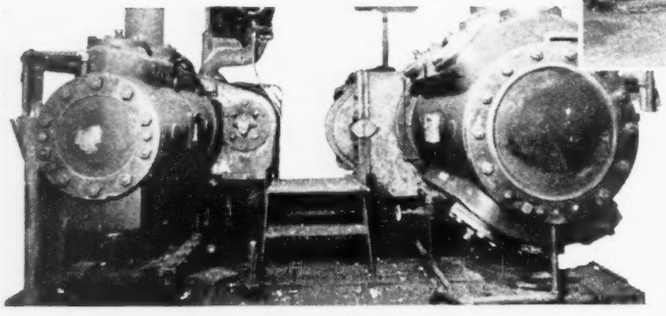


FOUR—B & W Stirling W.T. Boilers 685 HP each 200# pressure with Harrington Stokers—Complete, NEW 1926.



TWO—200 KW SKINNER UNIVERSAL UNAFLOW ENGINES —150# pressure 0-10 lbs backpressure each connected to a 230 Volt direct current generator 200 RPM complete with panel boards.

1—500 KW Hamilton Unaflow ENGINE 26x36 175 lbs. pressure 0-10 lbs back pressure connected to a Crocker Wheeler Generator 230 volt direct current 150 RPM complete with panelboard.



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16—Steel buildings with corrugated sheeting. From 50′ to 100′ wide from 100′ to 850′ long. 10 Miles of track from 60 to 100 lbs.

PLUS THESE BARGAINS

MACHINE TOOLS

1—Landis 72″ Roll Grinder 230 volt D.C. Motor Driven.
1—Hill Turret Lathe 22″ Swing 6 ft. bed 230 volt D.C. Motor Driven.
1—Saunders Pipe Threading Machine, 230 v. D.C. motor.
1—Schumaker & Boye Lathe 22″ Swing 8 ft. Bed.
1—Niles Bement & Pond Steam Hammer 1100 lbs. Cap.
1—Cordesman 18″ Rip Saw.
1—Cordesman 18″ Swing cut off saw.

CRANES

5—Morgan Overhead Traveling Cranes.
4—10 Ton capacity 55′ 6″ Span 3 Motor Drive complete with D.C. Motors, Controllers and Cabs.
1—10 Ton capacity 44′ 6″ Span 3 Motor Drive complete with D.C. Motors, Controls and Cabs.

Several thousand feet of Crane Runway is also available

AUTOMATIC STARTERS, 230 V., DC and SWITCH GEAR

1—1200 Amp. ITE Type LL S.P. Carbon Breakers.
5—600 Amp. ITE Type LL S.P. Carbon Breakers.
10—400 Amp. ITE Type LL S.P. Carbon Breakers.
16—G.E. 300 AMP 15000 Volt Oil Switches —FK12 with Manual Levers.
2—G.E. 500 AMP, 15000 Volt Oil Switches —FK12 with Manual Levers.
3—2 HP West.
12—3 HP Clark Varitime.
5—5 HP West & G.E.
24—7½ HP West & G.E.
12—15 HP West & G.E.
2—20 HP West.
1—25 HP West.
2—40 HP Clark.
2—50 HP Cutler Hammer.
1—60 HP Clark.

PUMPS

1—6500 G.P.M. Gould Pump—78 ft. head coupled to 1—150 HP, Type C.W. Westinghouse slip ring motor—208 volt, 3 phase, 60 cycle, 1200 RPM, with automatic panelboard complete. This unit is like new! Has been removed from the New York World's Fair. Will sell complete unit or motor and pump separately.
1—2100 gal. DeLaval pump, bronze fitted 130′ head, 1800 RPM, on CI base, with coupling.
1—3500 gal. DeLaval pump, bronze fitted 130′ head, 1800 RPM, CI base with coupling.

MOTORS

230 Volt Direct Current

1—15 HP G.E. RC 13—550 RPM
1—15 HP G.E. 800 RPM
1—7½ HP G.E. RC 1750 RPM
1—30 HP West SK 1150 RPM
1—20 HP West SK 1150 RPM
2—7½ HP West SK 850 RPM
1—125 HP BTS—1150 RPM 550 volt 3 ph. 60 cy. with starter.
1—150 HP G.E. Motor type T.S. 600 RPM 550 volt 3 ph. 60 cy. with direct conn. exciter.

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A.C.—Turbo Generators—Non Condensing

60 K.W. DeLaval 3/60/240/3600 RPM
100 K.W. G.E. 3/60/480/3600 RPM
300 K.W. West. 3/60/2300/900/6000 RPM
200 K.W. West. 3/60/2300/900/6000 RPM
500 K.W. West. 3/60/2300/900/6000 RPM
2—400 K.V.A. DeLaval 3/60/240/900/5000 RPM

A.S.M.E. BOILERS

Water Tube—160 lb.

Brand New While They Last

1—150 H.P. 1—250 H.P.
1—200 H.P. 1—300 H.P.
1—350 H.P.

LESS THAN HALF PRICE!

Turbo Generators—Direct Current

15 K.W. G.E. Non-Con. 125 v.
80 K.W. Terry Non-Cond. 125/250 volt
100 K.W. West. Non-Cond. 125 v.
100 K.W. G.E. Non-Cond. 230 v.
200 K.W. West. Non-Cond. 250 v.

A.C. Turbo Generators Condensing

2—250 K.W. Al.Ch. 2/60/240 Sur.
1—500 K.W. G.E. 2/60/2300 Sur.
1—1000 K.W. G.E. 2/60/2300 Sur.
1—300 K.W. G.E. 3/60/240 Jet
1—150 K.W. West. 3/60/240 Jet
1—750 K.W. G.E. 3/60/480 Surface
1—750 K.W. G.E. 3/60/2300 Bare
1—800 K.W. G.E. DeLaval 3/60/600 Jet
1—10000 K.W. West. 3/60/2300 Sur.
1—400 K.W. West. 3/60/2300 Sur.
1—4000 K.W. Al.Ch. 3/60/6600 Sur.

Rotary Converters

300 K.W. G.E. 600 v. DC 440 v. AC 1200 RPM
300 K.W. West. 250 v. DC 2300 v. AC 1200 RPM
500 K.W. G.E. 600 v. DC 440 v. AC 1200 RPM
750 K.W. G.E. 600 v. DC 440 v. AC 1200 RPM
750 K.W. G.E. 250 v. 6-ph. 900 RPM

3 phase-Steam Engine Sets —60 cycle

40 K.W. Harrisburg Piston Valve 220 volt
60 Harrisburg Uniflow 2300 v.
100 K.W. Skinner Automatic 220 v.
200 K.W. Skinner Uniflow 220 v.
300 K.W. Skinner Uniflow 2300 v.
850 K.W. Nordberg Uniflow 230 v.
160 K.W. Ames Uniflow 230 v.

Motor Generator Sets

5 K.W. Crocker Wheeler Balancing 125 v.
20 K.W. West. 125 v. 3/60/220
25 K.W. G.E. 125 v. 3/60/220
35 K.W. Burke 250 v. 3/60/220
50 K.W. El. Mchy. Co. 250 v. 3/60/4100 Syn.
60 K.W. G.E. 250 v. 3/60/220 Syn.
100 K.W. Cr. Wh. 125/250 v. 3/60/4000

Steam Engine Sets 125 Volt D.C.

8½ K.W. G. E. Marine Vertical
10 K.W. G.E. Marine Vertical
15 K.W. Troy-Engberg Vert. Mar.
20 K.W. G.E. Marine Vertical
25 K.W. G.E. Marine Vertical
35 K.W. G.E. Marine Vertical
75 K.W. Skinner Uniflow Horiz.
100 K.W. Ames Uniflow Horiz.
125 K.W. Skinner Uniflow Horiz.
150 K.W. Harrisburg Uniflow Horiz.
200 K.W. Skinner Uniflow Horiz.

Steam Engine Sets 250 Volt D.C.

450 K.W. Nordberg Uniflow Horiz.
300 K.W. Skinner Uniflow 3 wire

Steam Engine Sets (Con't) 250 Volt D.C.

300 K.W. Fitchburg 4 valve
250 K.W. Harrisburg Uniflow
400 K.W. Ridgeway 4 valve 3 wire
50 K.W. Ames Uniflow 3 wire

Air Compressors

Belt Driven

1072 Cu.Ft. Sullivan Class WJ3
868 Cu.Ft. Ingersoll Rand T. XCB
676 Cu.Ft. Ingersoll Rand T. XCB
600 Cu.Ft. Worthington
528 Cu.Ft. Ingersoll Rand 14x12 ER
368 Cu.Ft. Ingersoll Rand 12x10 ER
368 Cu.Ft. Worthington 12x10
254 Cu.Ft. Chicago Pn. 10x10 NSB
240 Cu.Ft. Pennsylvania AA 10x9
202 Cu.Ft. Chicago Pn. 8x6 Dup.
173 Cu.Ft. Ingersoll Rand 9x8 ER
140 Cu.Ft. Gardner Rix 8x6 Dup.
136 Cu.Ft. Chicago Pn. 8x8 NSB
120 Cu.Ft. Curtis 5½x5 Duplex
92 Cu.Ft. Pennsylvania 3A 7x6
92 Cu.Ft. Ingersoll Rand 7x6 ER

Low Pressure

1198 Cu.Ft. Ingersoll Rand XB
782 Cu.Ft. Ingersoll Rand 17x12 ER
503 Cu.Ft. Ingersoll Rand 14x10 ER
311 Cu.Ft. Ingersoll Rand 12x8 ER

Steam Driven

1832 Cu.Ft. Ing. Rand XPV 25 lb.
1400 Cu.Ft. Ing. Rand XPV 100 lb.
1300 Cu.Ft. Worthington 100 lb.
1156 Cu.Ft. Ing. Rand XPV 100 lb.
528 Cu.Ft. Ing. Rand FR 100 lb.
368 Cu.Ft. Ing. Rand FR 100 lb.
215 Cu.Ft. Ing. Rand FR 75 lb.
173 Cu.Ft. Ing. Rand FR 100 lb.
136 Cu.Ft. Gardner Denver 125 lb.
49 Cu.Ft. Westinghouse 150 lb.
35 Cu.Ft. Westinghouse 150 lb.

Aftercoolers

1500 Cu.Ft. Ingersoll Rand type VK
1200 Cu.Ft. Ingersoll Rand 86 HM-2

WE WILL BUY FOR CASH IMMEDIATELY GOOD EQUIPMENT

What Have You For Sale?

THE O'BRIEN MACHINERY CO.

115 NORTH THIRD STREET, PHILADELPHIA, PA.

Telephone: Market 0727 *Cable Address:* O'BRIEN, PHILA.

MOTORS • GENERATORS • TRANSFORMERS

Prices on application

3 PHASE—60 CYCLE 220/400 VOLT

H.P.	Make	RPM	Type	Frame
15	Allis-Chalm.	1750	2K54411	
20	Gen. Elec.	1750	KT	753
20	Gen. Elec.	600	I	K
25	Burke	900	EM	
40	Gen. Elec.	900	KT	336
40	Burke	1200	EM	45
40	Westing.	1750	CS	
50	Westing.	900	CS	
50	Gen. Elec.	900	KT	542
60	Burke	900	EM	7
60	Gen. Elec.	1200	I	K
60	Gen. Elec.	1800	I	K
75	Gen. Elec.	1200	KT	343
5) 75	Gen. Elec.	1200	I	K
75	Gen. Elec.	1800	I	K
75	Gen. Elec.	900	I	K
100	Burke	720	EM	10
100	Gen. Elec.	1750	I	K
100	Westing.	900	CS	
100	Lincoln	1200		
150	Gen. Elec.	1200	I	
150	Westing.	900	CS	
200	Gen. Elec.	600	I	K
200	Gen. Elec.	720	I	K
200	Gen. Elec.	900	I	K
200	Gen. Elec.	1200	I	K
250	Gen. Elec.	600	I	K
250	Gen. Elec.	720	I	K
250	Allis-Chalm.	900		
300	Gen. Elec.	720	I	K

Compensators in stock up to 300 H.P.

100 K.V.A. GENERATOR
For Diesel Use

1—100 KVA Crocker Wheeler 3/220/60 cy. 257 RPM. For direct connection to Diesel. 2 Bearing Machine with exciter and panels.

ANODIZING M. G. SET

1—1000 Amp. 60 Volt General Electric Generator, Type CD-115Y, 1200 RPM, direct connected to 90 H.P. General Electric Synchronous Motor, 3 phase, 60 cycle, 440 volt, 1200 RPM; 3-bearing Factory built machine, complete.

FREQUENCY CHANGERS

1—600 KW Gen. Elec. Syn. 2300 V., 25 cy. to 2300 V. 60 cy.
1—565 KVA Westinghouse Synch. 2200 V. 25 cy. to 220 V. 3 Ph. 60 cy.
2—400 KW General Electric Synch. 6600 V., 25 cycle to 440/2300 V. 60 cy.
1—150KW Gen. Elect. Type A.T.B. 3/60/220 V. direct connected to 200 HP. 3/25/2200 V. Motor with direct connected exciter.
1—125 KW G.E. ITT-565, 62½ cy., 3 ph., 235 V., 750 RPM. Ser. No. 5207711; dir. con. to 100 HP G.E. KT559 25/3/220/440/750 RPM.
1—60 KW G. E. ITT-546, 125 cy. 3 ph., 90 amps., 470 V., 8 P.F., Ser. No. 5207709.

SPECIAL MOTORS

1100 H.P. General Electric Synchronous Motor, 3 ph., 25 cy., 11,500/6600/2200 V., 375 RPM
1—500 H.P. Gen. Elect. Sync. 3/2200/60/1200 R.P.M. with Exciter. New.
500 H.P. Allis-Chalmers, 3 ph., 25 cy., 440 V., 490 R.P.M., Complete.
300 H.P. G.E. Slipring, 25 cy., 3 ph., 2200 V., 500 RPM, 3 bearing; complete with controls.
225 H.P. Electric Mchy. Co. Synchronous, 3 ph., 25 cy., 2200 V., 500 R.P.M. with controls.
2—100 H.P. G.E. Synch. Motors, 3 ph., 25 cy., 220/440 V., with control equipment.

BARGAIN

30—3 HP. General Electric Motors. 3/60/220/3600 rpm. $37.00 each.

TRANSFORMERS

Amt.	KVA	Make	Cycle	Voltage
3	40	Gen. Elec.	25	2200/440
3	50	Gen. Elec.	60	2200/220/440
2	75	West.	60	2200/120/240
3	100	Gen. Elec.	60	24/120/240
2	100	Gen. Elec.	60	4600/115/230
3	200	Gen. Elec.	25	13,200/240/480
3	333	Gen. Elec.	60	6900/230/460
3	500	Gen. Elec.	60	2200/220/440
3	500	Pittsburgh	25	11,500/100
3	1000	Pittsburgh	60	2300/4600/115
3	1000	KVA.Wagner	60	33000/2300

All Sizes and Voltages Available.

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

H.P.	Make	Type	Frame	RPM
300	Gen. Elec.	I	Form M	1185
75	Gen. Elec.	MT	537	1800
60	Gen. Elec.	MT	353	1800
60	Gen. Elec.(2)	MT	353	720
50	West.	CW	654C	1800
50	West.	CW	644C	900
50	West.	CW	654C	1800
40	Wagner	22WB		540
40	West.	CW	748	690
40	West.	CW	748	690
40	West.	CW	748	690
30	West.	HF	8B	1745
30	Gen. Elec.	MTC		1725
25	Gen. Elec.	MT	513	1800
25	Gen. Elec.	I	M	1200
25	West.	CW	750C	575
20	West.	CW	648A	575
20	West.	CW	644C	575
20	Gen. Elec.	MT	332	545
20	West.	CW	748A	575
20	West.	CW	748A	575
20	West.	CW	748A	575
15	Gen. Elec.	I-M		1725
15	Gen. Elec.	ITC		1725
10	Gen. Elec.	MT		1725

25 CYCLE, 3 PHASE, 440 VOLTS

H.P.	Make	Type	Serial	RPM
150	Gen. Elec.	MT563Y	5056230	725
125	Gen. Elec.	I-17	4550934	360
50	Gen. Elec.	MT547	5264084	720
50	Gen. Elec.	MT353	3879210	750
50	Allis-Chal.		7923K	715
52	Gen. Elec.	ITC5013	1773223	700
40	Gen. Elec.	MT543	4817983	750
40	Gen. Elec.	MT343	3887755	750

GENERATOR & EXCITER

1—62½ KVA 3 ph. 60 cy. 240 v. 1200 rpm Allis-Chalmers generator, serial No. 113797, with exciter, direct Connected stock No. E11317. Comp. with Base Pulley and Panel.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

NOTEWORTHY EQUIPMENT

2—75 H.P. Elect. Machinery Co. 440 Volts, 60 cycle, 3 ph. 150 RPM., two bearing, pedestal type synchronous motors, equipped with Cutler Hammer magnetic clutches — full automatic Cutler Hammer Control — separate M.G. set with excitation.

1—250 H.P. G.E. type ATI, 50% P.F. 2200 V. 60 Cy. 3 Ph. 1200 RPM with direct connected exciter and complete hand control equipment, 350 KVA continuous.

1—200 KVA Westinghouse, 440 volts, 60 cycle, 3 ph. 900 RPM., A.C. two bearing, pedestal type, generator with direct connected exciter and panel. Can be used as synchronous motor.

1—200 H.P. G.E. 2200 volts, 60 cycle, 3 ph. 900 RPM., two bearing, bracket type, synchronous motor, with belted exciter — hand control.

SPECIAL DC 230 VOLTS

1—50 HP Electro Dynamic 400 RPM 3 bearing pedestal equipped with ball bearings, compound wound interpole.

2—50 HP Bullock 550 RPM 2 bearing pedestal type shunt wound.

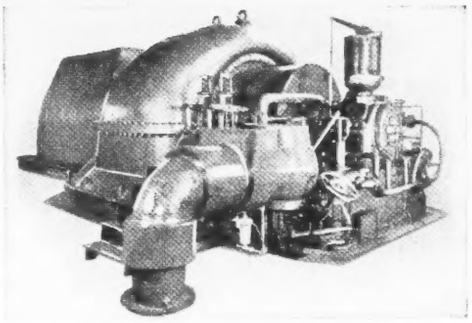
Approximately 4000 other AC-DC Motors — Motor Generator Sets — Transformers—Pumps—Fans—Compressors—Hoists, etc.

PENN ELECTRICAL ENGINEERING COMPANY

SCRANTON, PA.

PRIME MOVER POWER EQUIPMENT

At Priceless Advantage in Immediate Delivery and 50% Saving on First Cost Investment



Typical of 12500 KVA, 14000 KVA Max Turbine.

TURBOS 60 Cycle

√ 12500 KVA GE Curtis 60/3/12000/1800 RPM 200/240#—Surface Condenser

√ 2—10000 KW Wemco CW Imp & Reac 60/3/11000 and 2300/1800 RPM—with or without Condenser

7500 KW GE Curtis 60/3/6600/1800 RPM/175#—Surface Condenser

5000 KW GE Curtis 5-stage 60/3/13200/3600—200/225#—Jet Condenser Limited log service

√ 4000/5000 KW Wemco CW IMP&REAC Noncondensing Turbo, 200 lb. ISP 45 lb. GBP 60/3/2300/1800 RPM.

1—4000 KW GE 60/3/6600/1800 RPM—150#—Surface Condensers

2—3000 KW Wemco Parsons Single Flow Reac 60/3/4400/1200—Surface Conds.

3125 KVA Lynn Type GE Rigid Frame 60/3/2300/3600 RPM. Surface Condenser.

2500 KVA Wemco Imp & Reac 60/3/2300/3600 RPM. Surface Condenser. Rare short log service.

937 KVA GE Bleeder 60/3/2300/3600 RPM 200#. Condenser.

TURBOS 60 Cycle

Continued

√ 2—625 KVA Wemco 10-C Parsons or NC 60/3/440/2200/3600 —Jet Condenser—Surface avail.

300 KW Wemco Single Wheel Re-entry 60/3/240—120/250#.

TURBOS 25 Cycle

6000 KW GE Curtis 25/3/6600/1500 RPM—Jet Condenser—Surface avail.
2—6000 Wemco Impulse & Reaction Semi-Double Flow—25/3/2300 & 13200—Surface Condenser
2—3500 KW Imp & Reac 25/3/13200—Surface Condenser.
2—1500 KW Wemco 25/3/2400/1500—Condensers.

MOTOR GENERATORS

1500 KW Type MPC 60/3/4000: 600 volts—360 RPM
Several 500's also available 250—600 volts

BOILERS

√ 1—750 HP Stirling Bent Tube 200#—Superheaters and Stokers 2—600 HP

8-600 HP B&W Vertical Steel Header Long. 3-drum 200# Superheater and Taylor Stokers.

3—500 HP Edgemoor Steel Header Boilers—200#—Foster Superheaters

√ 1—389 HP B&W Stirling Water Tube ASME and Hartford—200#—Stokers and all auxiliaries

ROTARY CONVERTERS 60 Cycle

2—1000 KW Wemco 60/6/650 DC—900 RPM

ROTARY CONVERTERS 25 Cycle

3500 KW GE Syn Booster 3/6 ph—250 DC—167 RPM—Transformers 11000: 196 volts.

√ 1—2000 Wemco Shunt Wound Booster Type Syn 25/3/191: 270 DC—300 RPM Transformers 4000:191 volts

FREQUENCY CHANGERS: 2000 KVA, 62½ cy.; 1000, 3000 KW, 60 cy.
CONDENSERS-SURFACE:—25000 to 1000 sq. ft.
MOTOR GENERATORS: 60/25 cycles 1500 to 300 KW
MOTORS: 60 cycles 4000-1000 HP.
TRANSFORMERS: 60/25 cycles—15000 to 500 KW
TURBOS: 4000-300 KW 60 cycles—many choice units not listed.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt Street
New York, N. Y.

W T BOILERS

728 HP Erie City, 200 lbs.
600 HP (8) B & W 200 lbs.
525 HP (2) Springfield cr drum; 225 lbs.
500 HP Heine 200 lbs.; used 8 years.
500 HP (2) Heine, 225 lbs.
484 HP Springfield, cr drum, 200 lbs.; used 1900 days.
400 HP (2) Heine, cr drum, 160 lbs.
357 HP (2) Casey Hedges; 175 lbs.
389 HP Sterling 200 lbs.; new 1929.
300 HP Heine; 175 lbs.; new 1927
300 HP (2) B & W 200 lbs.
252 HP Combustion Eng'g, low head. 160 lbs. with Detroit Stokers; new 1933.
332 HP (2) Edgemoor 200 lbs.

A C TURBINE UNITS

10,000 KW General Electric
7500 KW (2) General Electric
5000 KW G. E. 550°
5000 KW Westinghouse
4000 KW (2) General Electric
4000 KW Westinghouse
2500 KW General Electric
2000 KW (2) Westinghouse
2000 KW General Electric
1500 KW Allis Chalmers
1250 KW G. E. (bleeder)
1000 KW General Electric
1000 KW Wghse. (bleeder)
750 KW Wghse. 550°.
750 KW Al. Chal. 550°.
750 KW Al. Chal. (mixed pres.)
750 KW G. E. (bleeder)
625 KW Al. Chal. (bleeder)
500 KW Allis Chalmers
500 KW G. E. (bleeder)
300 KW (2) General Electric
125 KW Westinghouse

NON-COND. A. C. TURBINE UNITS

300 KW (2) General Electric
250 KW C. W.—Moore, 450 lbs.
100 KW Wghse.; 40 lbs. b.p.
60 KW Allis Chalmers
30 KW Westinghouse

A. C. UNITS

1440 KVA Wghse.-Hamilton Corliss
500 KVA G.E.-Skinner Unif.
312 KVA G.E.-Skinner Unif.
250 KVA G.E.-E.B. 4 V.
150 KVA G.E.-Skinner Unif.
100 KVA G.E.-Skinner Unif.
60 KVA G.E.-Skinner Unif.

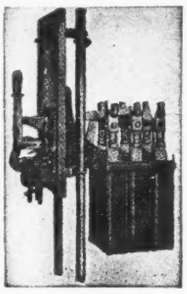
DIRECT CURRENT UNITS

300 KW 250 V.-Murray Corliss
300 KW 250 V.-Skinner Unif.
150 KW 250 V. G.E.-Skinner Unif.
100 KW 250 V. E.B.-4 V.
100 KW 125 V. G.E.-E.B. 4 V.

Oil Heating and Pumping Unit: suitable for 1000 to 5000 HP in boilers.

Engine: 22 x 36 Nordberg Uniflow; (twin) 20 x 21 Skinner Uniflow (15 to 20# b.p.)

Do You Need Circuit Breakers?

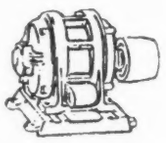


OIL CIRCUIT BREAKERS
All 3 Pole—Single Throw

Qn.	Amp.	Make	Type	Volts
10	200	G.E.	FK20	2500
25	300	G.E.	FK12	15300
6	400	Condit	E4	7500
2	400	G.E.	FK132B	15000
8	400	West.	F22	7500
25	500	G.E.	FK12	15000
5	600	West.	F22	7500
2	600	G.E.	FK35	600
1	600	G.E.	FK132B	15000
2	800	Condit	E4	4500
4	800	G.E.	FK5	4500
2	800	G.E.	FK132A	15000
5	1000	G.E.	FK12	4500
2	1200	West.	B	3300
6	1200	G.E.	FK12	4500
1	1500	G.E.	FK12	4500
1	2000	G.E.	FK12	4500
1	5000	G.E.	FK25	600

AIR CIRCUIT BREAKERS

5	500	G.E.	CK	220	3	sgl.	2 trips
1	600	ITE		440	3	sgl.	2 trips
2	1000	West.	CA	600	3	sgl.	2 trips
1	1200	ITE	LL	220	3	sgl.	2 trips
1	3000	Roller Smith		220	3	sgl.	3 trips
1	5000	ITE		220	3	sgl.	2 trips



Do You Need Motors — Generators — Transformers?

2 — Worthington Syn. Ice Machines 150 and 225 H.P. Still on Location—Details on application.
150 KW—600 v G.E. M.G. Set 230 v—60 cy. Syn. Drive.
3 — 333 KVA G.E. Trans. 6900-230/460—60 cy.
1 — 500 KW—600 v G.E. Syn. Rotary Convertor.
150 HP 2200 v G.E. Slip Ring Motor 600 speed.
200 HP 2200 v G.E. Slip Ring Motor 600 speed.
300 KW 250 v G.E. 25 cy. Synchronous Rotary.
300 West. Type C W Slip Ring 440/25/3/500 speed.
25 KW West. M.G. set 125 v DC to 220/60/3/1800 A.C.

Above partial listings. Send us all inquiries and list of what you have for sale

ELECTRIC EQUIPMENT CO.

347 No. Clinton St.
ROCHESTER, N. Y.

Subsidiary Co.—CIRCUIT BREAKER CO., Dealers in Air and Oil Circuit Breakers

WEXLER ELECTRIC MOTOR CO.

210 LAFAYETTE STREET — **NEW YORK, N. Y.**

Slipring Motors

HP	Make	Type	RPM
200	West.	CI	600
100	West.	CI	1800*
75	West.	CI	1800*
60	G.E.	MT	1800*
60	Howell	SR	1150
50	C.W.		1150
50	A.C.		850
50	West.	CW	690
40	G.E.	IM	870
40	West.	CW	870
40	G.E.	I-12	570
30/15	West.	CW	1150/575
30	Wagner		850
30	Imperial	BS	850
25	West.	CW	1750
25	G.E.	ITE	1150
25	Howell	SR	900
25	Burke	MV	850
25	G.E.	MTB	600*
20	Cleve.	CIX	1150
20	Wagner	TBR	1150
20	West.	CS	600
20	G.E.	MTB	600*
20	G.E.	MT	720*
15	G.E.	MT	1150
15	G.E.	MC	1150

2200 Volt Motors

100	G.E.	MT-558	720
20	G.E.	KT-522	1150*
25/30	G.E.	MT-513	1750
25	G.E.	MT-532	850*
25	G.E.	MT-592	600*
40	G.E.	MT-536	850*
40	G.E.	MT-546	685*

Squirrel Cage Motors

HP	Make	Type	RPM
115	G.E.	IE	1150
100	West.	CS	1750
100	G.E.	KTR	850
75	G.E.	KT	690
50	G.E.	KT	1800
50	G.E.	KT	870
50/25	G.E.	KG	1750/870*
40	G.E.	KT	1150
40	R.M.	K	870
40	G.E.	KT	850
40	West.	CS	720
30	G.E.	FT	3450
30	Watson	K	1750
30	L.A.	AR	1750
30	Imperial	EH	580
25	G.E.	KF	1750
25	Starr	AL	1750
25	Relia.	B	1750
25	West.	CS	1150
25	G.E.	KT	1150
25	Al. Ch.	AR	1150*
25	Ai. Ch.	AR	850
25	Howell	CS	850
25	Cent'y	AS	850
20	West.	CS	1750
20	G.E.	KT	1750
20	G.E.	KG	1750*
20	U.S.	KF	1750*
20	G.E.	KT	1150
20	G.E.	FTR	1150
20	West.	CS	1150
20	G.E.	I-6	1150
20	G.E.	FT	850*
20	G.E.	KT	865

AC Crane Hoist

HP	Make	Type	RPM
200	West.	CI868A	600
100	West.	CI663C	1800
100	G.E.	KTR546	850
75	West.	CI653C	1750
60	West.	CI587C	1750
40	P&H	AW110	900
40	G.E.	MTC5526	840
40	G.E.	MTC5536	600
40	G.E.	KTR543	1600/1000
35	G.E.	MTC5536	*600
35	West.	CI586D	870
30	G.E.	MTC5532	600
30	G.E.	KTE522	1040
30	Leln.	HXI	900
25	West.	CS	785
20	West.	CS	960
20	G.E.	MTE322	660
20	Relia.	RA	750
15	West.	CS	660
15	G.E.	KR	1000
12	G.E.	KTE956	1050
10	G.E.	KR	900

DC Crane Hoist

43	G.E.	CO_{2004}	
40	G.E.	CO_{2004}	
40	West.	SK	950
25	West.	$CK_{7\frac{1}{2}}$	925
15	G.E.	CDE	900
10	N.W.	K_3A	1050

*Unused—original crate.

DC 230 V. Variable Speed

HP	Make	Type	RPM
80	Sprague	LC	480/1100
60	Sprague	LC	600/1100
25	El. Dyn.		600/1100
25	Sprague	LC	750/1500
15	Diehl	FCL	375/750
15	G.E.	CR	400/1200
10	Sprague	LC	850/1500
9	Reliance	F	450/1850
$7\frac{1}{2}$	G.E.	RF	450/1800
$7\frac{1}{2}$	El. Dyn.	IOS	225/380
$6\frac{3}{4}$	GE	RLC	500/1500
$5\frac{1}{2}$	West.	SK	600/1800
$5/7\frac{1}{2}$	Rel.	T_{46}	600/1800
5	G.E.	RF	650/1950
5	G.E.	RF	300/1200
5	El. Dyn.	S_3	550/1650
5	El. Dyn.	$7\frac{1}{2}S$	225/900
5	Star	SB	600/1200
5	C.W.	CM	575/850
5	Sprague	LC	800/1500
5	Ideal	DE	750/1150
5	G.E.	RLC	500/1500
5	C.W.	CMC	450/1800
$3\frac{1}{2}$	G.E.	RF	450/1800
$3\frac{1}{2}$	West.	SK	450/1800

LARGE STOCK OF
MOTORS — INDUSTRIAL
GENERATORS — CONTROL
M-G SETS — WELDERS
TRANS-FORMERS — PUMPS
SPEED REDUCERS

REBUILT POWER EQUIPMENT—Ready to Ship

A.C. and D.C. MOTORS—1 H.P. to 1,000 H.P.

MOTOR GENERATOR SETS
3 ph. 60 cy.—Synchronous

300 kw. Crocker Wheeler 250 v. D.C. 720 rpm. 440/220/3/60.
300 kw. Crocker Wheeler 250 v. DC 720 rpm., 2200/440/220/3/60 Induction.
2—150 kw. Ridge 250 V. D.C. 2200 V. 900 rpm.
1—100 kw. Ridgway 250 V., D.C., 2300 A.C., 1200 rpm
100 kw. West. 250 v. 900 rpm., 2200/3/60 900 rpm.
75 kw. West. 250 v. V belted to 2200/3/60 Syn Motor

ROTARY CONVERTER
100 kw. G.E. Synchronous 275 V. 1200 rpm. 2300/4000 transformers.

100 HP. LIDGERWOOD HOIST
Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS
219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)
125 kva. West. 2300/3/60 900 rpm.
1—125 kva. Elec. Mchy. 220/3/60 900 rpm.

SPECIALS IN SLIPRING MOTORS
3ph. 60 cy.

HP	Make	Speed	Type
750	Cr. Wh.	250	601
700	G.E.	393	MT-432
400	West.	1170	CW
260	Burke.	600	EM-65
250	G.E.	590	I-174
200	West.	690	CW-956A
150	G.E.	580	I
100	West.	1750	CI

SYNCHRONOUS MOTOR
225 HP. G.E. 2200 v. 3 ph. 60 cy. 80% P.F. (Can reconnect 440 or 220 v.)

A.C. STEAM ENGINE GENERATOR SET
175 kw. G.E. 2200/3/60 dir. con. Ridgway Engine.

A.C. MOTORS—3 ph. 60 cy.

HP	Volts	Make	Type	Speed
300	2200/440/220	West	CS	450
350	2200/440/220	West	CS	450
400	2200/440/220	West	CS	500
450	2200/440/220	West	CS	600
500	2200/440/220	West	CS	720
600	2200/440/220	West	CS	900
300	2300	West.	CS	1200
300	220/440	West.	CS	1150
275	2200	West.	CS	1800
250	2200	West.	CS	1200
250	220/440	West.	CS	900
225	2200	West.	CS	900
200	220/440	West.	CS	600
200	220/440	West.	CS	720
200	220/440	West.	CS	1200
200	2200	G.E.	IK-15	1200
200	2200/440/220	West	CS	250
175	220/440	West.	CS	900
150	2300	West.	Syn.	900
150	220/440	West.	CSi	1800

230 V. VARIABLE SPEED MOTORS

HP	Make	Type	Speed
25	Reliance	MT-230T	500/1500
25	West.	SK	825/1625
20	West.	SK-133	575/1150
20	West.	SK-160	150/450
15	Louis Allis	NA	1150/1750
15	West.	SK-100L	600/1200
10	G.E.	LC	625/1250
10	Reliance	TF-78	500/1500
10	West.	SK	600/1200

2—MOTOR CRANES

Tons	Span	Make	Volts
5	40'	Bedford	230 v. DC
5	73½'	Bedford	230 v. DC
7½	40'	Bedford	230 v. DC
7½	60'	Bedford	220 v. AC
10	40'	Bedford	220 v. AC
15	50'	Bedford	230 v. DC
15	64½'	Bedford	230 v. DC
20	50'	Bedford	220 v. AC
20	73½'	Bedford	230 v. DC
25	64½'	Bedford	230 v. DC

SPEED REDUCERS
14—3 HP. 400 Ah. Cleveland ratio 60:1.
23—3 to 5 HP. Thomas 2 speed ratio 1 side 100 to 1 other side 5 to 1.
5—10 HP. 600 At Cleveland ratio 90:1.
1—150 HP. R.D. Nuttal ratio 1.6:1.

AIR COMPRESSORS
2— 15 cfm G.E. 90# pres. 2300 D.C.
1— 50 cfm Sullivan 1 cyl. horiz. 100# pres. 6x6.
1—485 cfm Ingersoll-Rand 14-10 single cyl. horiz. 60#.

SERIES WOUND MOTORS—230 V. D.C.
1—5 HP. G.E. CO-3, 725 rpm.
1—10 HP. G.E. CO-7½, 6500 rpm.
2—25 HP. Milwaukee 400 rpm.
1—50 HP. G.E. MDS106, 600 rpm.
3—50 HP. West. 38B, 500 rpm.

TRANSFORMERS—1 ph. 60 cy.
1—100 kva. West. 2200-220/110.
3— 50 kva. Packard 2200-2300/115.
3—37½ kva. West. 22000-2200.
2—2500 Kva. G.E. 2300-220/440.
6— 10 kva. Pgh. 2200-220/110.

D.C. TURBO UNIT
300 kw. 250 v. Cr. Wh. Kerr Steam Turbine, non condensing.

GAS ENGINE GENERATOR SET
75 kw. West. 250 v. belted to 110 HP 2 cyl. Bessemer Gas Engine.

D.C. GENERATOR
300 kw. Cr. Wh. 250 v., 720 rpm.

250 V. D.C. MOTOR
400 HP Crocker Wheeler 250 v., 600 rpm.

STOKER
Detroit Underfeed Stoker complete (was used with 277 HP. Boiler).

DUQUESNE ELECTRIC & MFG. CO., Pittsburgh, Pa.

Let MacCABE lift your Worries!

(about CRANES • HOISTS • MOTORS • CONTROLLERS)

OVERHEAD ELECTRIC TRAVELING CRANES

	TON	MAKE	SPAN	CURRENT
(3)—	2	Shepard (x)	18'8"	230-VDC
(1)—	3	Northern	29'6"	440-VAC
(1)—	3	P&H (x)	29'6"	220-VAC
(1)—	3	Shepard (x)	34'0"	A.C. or D.C.
(1)—	3	P&H (Transfer)	44'0"	A.C. or D.C.
(1)—	3	Euclid	56'11"	A.C. or D.C.
(1)—	5	Niles	35'0"	230-VDC
(1)—	5	Euclid	34'3"	A.C. or D.C.
(1)—	5	Whiting	43'4 3/9"	230-VDC
(1)—	5	P&H	47'10"	230-VDC
(2)—	5	Whiting	59'0"	220-VAC
(1)—	7½	Morgan	46'6"	230-VDC
(1)—	10	Niles	61'3½"	230-VDC
(1)—	15/5	P&H	35'2"	230-VDC
(1)—	15	Toledo	40'2"	230-VAC
(1)—	15	P&H	41'7"	230-VDC
(3)—	15	Morgan	55'6"	230-VDC
(1)—	100	Ladle Crane	51'0"	230-VDC

(Cranes marked (x) are single girder motorized bridges with 2-motor Monorail hoists. Floor or Cage Operated. Cranes marked A.C. or D.C. can be furnished, rebuilt with either type of electrical equipment.)

BUCKET HANDLING OVERHEAD CRANES
(1) Whiting 18'8" span, 230-VDC., 4-motors, 2-yd. cap.
(2)—Niles 55'0" span, 230-VDC., 4 motors, 1½-yd. cap.

ELECTRIC MONORAIL HOISTS
(25)—¼ to 3-ton Shepard 115 & 230-VDC
(10)—½ to 3-ton Y&T, Box, Link Belt, 220-VAC
(8)—1 to 3-ton Shepard, 2-motor, 230-VDC. FL. or CG. Operated.

AIR HOISTS
(5)—; & 2-ton Ingersoll Rand.
(1)—2-ton Chicago Pneumatic.

BUCKETS
(1)—¾ yd. Blaw Knox single line.
(1)—1½ yd. Brosius single line.
(1)—¾-yd. Hayward Elec. 220/3/60-cy.
(2)—1-yd. Hayward Electric 230-VDC.
(1)—2-yd. Blaw Knox 2-line.

AIR COMPRESSORS
(1)—12x10 Penna. 360-CFM. with 60-Hp. Crocker Wheeler slip ring motor, 220/3/60 cycle.
(1)—12x12 Chicago N.S.B. 378-CFM.
(1)—Ingersol Rand XRE #97020 & 1, size 16 & 10½ x 12, direct connected 125-HP. G.E. SYN MOTOR, 2300-V, 3-PH., 60-CY. P.B. panel, inter and after cooler.

CRANE & MILL MOTORS
(65)—G.E. C.O. 1802 to 1810 Incl. 230-VDC.
(25)—G.E. C.O. 2502 to 2506 Incl. 230-VDC.
(40)—Westinghouse K-1 to K-10 Incl. 230-VDC.
(22)—Westinghouse MCA & MCB #20 to 100 Incl. 230-VDC.
(2)—G.E. M.D.P.—9½-HP. 230-VDC.
(1)—G.E. MD-406, 19-HP.
(2)—G.E. MD-104½ & 106, 30 & 60-HP. 230-VDC.
(12)—P&H. 2 to 25-HP. 230-VDC.
(40)—G.E. & Westghse. 2 to 50-HP. 220/440-VAC.
(100)—Drum Controllers D.C. & A.C. 3 to 75-HP.
(15)—EC&M Dinky type 230-VDC. to 50-HP.
(7)—EC&M Dinky type 230-VDC. to 30-HP. Dynamic.

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4306 CLARISSO STREET PHILADELPHIA, PA.

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750 KW TURBINE

Westinghouse Mixed Pressure 110# H. P. 2 to 4" L. P. 3600 RPM with gear box to 900 RPM with accessories. (Formerly connected to 750 KW 250 v. 900 RPM Gen.
(Will also rate 900 HP 75% P.F. Syn. Motors)

M-G SETS 3 ph. 60 cy. (Syn.)

3—150 KW G.E. 500 v. DC—2200 v. AC 1200 RPM .8 P.F. ATI
150 KW Ridg. 275 v. DC—2200 v. AC 900 RPM
2—100 KW G.E. 275 v. Type MPC cp. wd. interpoles dir. con. to 150 HP G.E. 740C. Leading P.F. Type ATI 2330 v. 3 ph. 1200 RPM Syn. Motors. With or without switchboard panels.
100 KW Ridg. 275 v. DC—2200 v. AC 1200 RPM
90 KW Allis 250 v. DC—2200 v. AC 900 RPM
75 KW Westgh. 250 v. DC—2200 v. AC 900 RPM

ENGINE GENERATOR SETS

100 KW 250 v. DC. Westgh.—Skinner Engine

SYN. MOTORS 3 ph. 60 cy.

HP	Make	Volts	Speed
350	A.C.	2200	600
2-175	Westgh. .8 P. F.	2200	600
2- 75	G.E.	2200	900
75	Westgh.	220	1800

SLIP RING & SQ. CG. MOTORS

(3 ph. 60 cy.)

HP	Make	Speed	Wdg.	Type
700	G.E.	393	S.R.	MT432
400	West.	500	S.C.	CS
300	West.	490	S.C.	CS
200	West.	580	S.R.	CW
200	Cr. Wh.	440	S.R.	28
200	G.E.	700	S.R.	I M
200	Al. Ch.	600	S.C.	
150	West.	720	S.C.	CS
125	Al. Ch.	435	S.R.	
100	G.E.	720	S.C.	I K
100	F. M.	600	S.C.	BB
75	G.E.	690	S.R.	I M
75	West.	900	S.R.	CW752C
75	West.	690	S.R.	CW754C
75	West.	575	S.R.	CW868A

DC VARIABLE MOTORS (230 VOLTS)

HP	Type	Make	Speed
20	SK	Westgh.	900/1800
15 (1)	SK	Westgh.	400/1600
10	SK	Westgh.	600/1200
5	SK	Westgh.	450/1800

300 HP D.C. VARIABLE SPEED MOTOR

Westgh. 230 v. 250/500 RPM interpole #8099644

AC GENERATOR

219 KVA G.E. TRE 2400/480/240 v. 3 ph. 60 cy. 200 RPM with exc.

AIR COMPRESSORS

846 cu. ft. 65# Ing. Rand 2 stage ERI
550 cu. ft. 100# Bury 2 stage
400 cu. ft. 50# Bury 16x10
355 cu. ft. 100# Laidlow Dunn
225 cu. ft. 100# Sullivan WK 26
160 cu. ft. Chic. Pneu. 100#
140 cu. ft. Gardner Rix 100#
67 cu. ft. Ing. Rand ER 1 100#

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Chicago Pneumatic simplate-valve Type NS03 straight line 16½" & 11" x 18" cap. 492 cu. ft. 100# pres. with air receiver and starting air compressor.

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WELDERS: ARC & SPOT: Arc 75 to 1500 Amp. Spot 5 to 175 K.V.A.

BOILERS: 1½ to 1000 H.P. H.R.T., Vertical & Water Tube.

PUMPS: 2 to 5000 G.P.M. Centrifugal Vertical Triplex, Vacuum, Hydraulic & Steam.

TRANSFORMERS: 3 to 5000 K.V.A. Single & Three Phase.

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TURBO UNITS 60 CYCLE

1—10,000 KW West. high pressure cond.
1— 4,000 KVA Allis-Chalmers same.
2— 3,125 KVA G. E. same.
1— 1,500 KW West. same.
1— 600 KW G. E. same.

A. C. SLIP RING MOTORS

1—1,000 HP West. 3 ph. 60 cy. 360 RPM.
1— 750 HP, 25 cy. 90 RPM.

SUB STATION

1—200 KW West. 60 cy. 250 volt D.C. Rotary Converter.
1—150 KW West. Syn. MG Set, 250 v. D.C.
1—100 KW. G. E. same.

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66750—CFM. 1150 Rev. 2" to 6" S.P.
1500'-2 stage compressor—syn. mtr. dr.
3—100 kw. 125-250 v. non. cond. turbos.

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Diesel Electric Plant

1—50 KVA 60 Cy—3 Ph—220 Volts Caterpillar Engine Driven Unit with Switch Board.
1—60 KVA Same As Above.

Belted Alternators

1—225 KVA 60 Cy—3 Ph—600 RPM Allis Chal. 2300 Volts. 3 Bearing with Exciter.
1—300 KVA Same as Above.

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Straight tube, 260 HP, 200 lbs. pressure, superheater and Illinois chain grate stoker.

Used eight years

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300 KW ROTARY CONVERTERS

2—300 KW Burke Rotary Converters, 250 volts D.C., rolled steel frames, 6 phase, 60 cycles with transformers and swbds.

ADJUSTABLE SPEED MOTORS

2—50 H.P. Crocker Wheeler Type CMC Size 65 H Adjustable Speed Motors, 230 volts D.C., 400/1200 R.P.M., with Rollway Roller Bearings.

75 KW MOTOR GENERATOR SET

2—75 KW GECo Induction MG Sets, 250 V-DC, 3-60-220/440 V-AC, 1200 RPM, with switchboards.

300 KW ROTARY CONVERTER

1—300 KW Westinghouse Rotary Converter, 600 volts D.C. 6 ph., 60 cy., pedestal bearings, 1200 RPM.

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ADJUSTABLE SPEED MOTORS D.C.
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SQ. CAGE & SLIP RING MOTORS A.C.
SYNCHRONOUS MOTORS A.C.
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CRANE MOTORS

1—MDS 109½, 1—MC90, 2—38-B, 1—CO 1812, 1—MDS 108, 1—CO 2007, 3—CO 2004, 3—CO 2002, 2—12A, 1—48

300 H.P. MILL MOTOR

1—300 HP GECo Type MPC form A Mill Motor, 230V-DC, 500 RPM, comp. wound, mag. rev. control.

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1—300# Detroit Electric Furnace, Type LFA for 440 volts A.C. Used 6 months.

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1—625 KVA West., 3 ph., 62½ cy., 480/2300 v., 750 RPM, 750 HP, 3 ph., 25 cy., 4000/2300 v., starts from either end. Comp. switchboards.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

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1—10000 KW. West. 2400 V. Cond.
1— 7500 KW. GE. 6600 V. Cond.
1— 5000 KW. GE. 13,200 V. Cond.
1— 4000 KW. GE. 6600 V. Cond.
1— 3000 KW. GE. 600 V. Cond.
1— 2500 KW. G.E. 600 V. Cond.
1— 1400 KW. West. 600 V. L.P. Cond.
1— 625 KW Terry-Allis—600 V. Cond.
1— 500 KW. GE. 2300 V. Mixed P.
1— 500 KW. GE. 600 V. Cond.
1—175 H.P. G.E. Turbine—only

AIR COMPRESSORS

1—1190 Cu. Ft.—IR—2 stage Direct Motor Driven.
1—1580 Cu. Ft.—IR—2 stage Direct Motor Driven.
1— 888 Cu. Ft.—IR—2 stage Steam Driven.
1— 599 Cu. Ft.—IR—2 stage Belted
2— 549 Cu. Ft.—IR—Duplex 35# pressure.
1— 173 Cu. Ft.—IR—ERI Belted.
1— 146 Cu. Ft.—IR—3 stage Belted 2000#

G.E. CENTRIFUGAL COMPRESSOR

Type WM—675—8800/10800.
Volume—8800/10800 Pressure 32/39.6.
Driven by 820 H.P. G.E. Turbine.
Condition excellent.

BOILERS

2—1000 H.P. Heine—275#
2— 600 H.P. B&W—200#
2— 500 H.P. Heine—250#
1— 340 H.P. B&W Sterling—150#
2— 160 H.P. B&W Sterling—155#
1— 167 H.P. HRT—150#
1— 60 H.P. HRT—125#

MOTOR GENERATOR

1—75 KW. West. 2200/250 V. 3-wire, CI.

BELTED GENERATOR

1—500 KW. G.E. 550 V. 225—RPM.

PUMPS

1—4000 GPM, DeLaval Cent. 195 Ft. Head Driven by 300 H.P. G.E., 2200 V. motor
1—3000 GPM, DeLaval Cent. 290 Ft. Head Driven by 300 H.P. G.E., 2200 V. motor
1—1500 GPM, DeLaval Cent. 290 Ft. Head Driven by 200 H.P. G.E., 2200 V. motor
1—1500 GPM, Gould Fire Pump, 231 Ft. Head Driven by 150 H.P. G.E., 2200 V. motor
2—1200 GPM, Worth. Cent., 180 Ft. Head Driven by 75 H.P. G.E., 2300 V. motor
1— 750 GPM, Worth. Fire Pump, 16x9x12 Steam Driven. This item never used.

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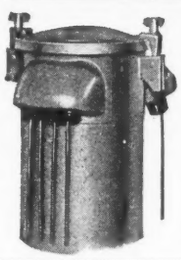

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250 KW West. Rotary 275 Volt D.C. 6900 Volt A.C.
100 KW West. Rotary 275 Volt D.C. 2300 Volt A.C.
75 KW West. M.G. Set 250 V. D.C. 440 V. A.C.
50 KW Allis-Chalmers 250 V. D.C. 2200 V. A.C.
15 KW Burke 125 Volt D.C. 220 Volt A.C.

SYNCHRONOUS MOTORS 3 phase 60 cycle
2—G.E. 700 HP 720 RPM 6600/4000/2300 Volt
Burke 300 HP 900 RPM 440/220 Volt
G. E. 200 HP 720 RPM 440/220 Volt
Ridgway 150 HP 1200 RPM 2200/440 Volt
Electric Machinery 150 HP 720 RPM 73 P.F. 440 V.
G. E. 125 HP 277 RPM 440/220 Volt
C. W. 100 HP 900 RPM 440/220 Volt
Fairbanks-Morse 75 HP 720 RPM 220 Volt
G. E. 60 HP 720 RPM 440/220 Volt

SLIP RING MOTORS 3 phase 60 cycle
West. 150 HP 720 RPM 550 Volt
G. E. 60 HP 720 RPM 440/220 Volt

SLIP RING MOTORS, 3 phase 60 cycle—Cont.
Allis-Chalm. 250 HP 600 RPM 440/220 Volt
Burke 100 HP 1200 RPM 440/220 Volt

ADJUSTABLE SPEED 230 Volt D.C. Motors
1—West. SK-201, 150 HP, 350/900 RPM
1—G.E. RF-18 90/120 HP 400/1200 RPM
2—Reliance 1400-T 100/125 HP 300/900 RPM
1—West. SK-180 100 HP 600/950 RPM
1—West. SK-180 45/90 HP 475/950 RPM
1—Diehl 50 HP 400/1200 RPM
1—Reliance 1400-T 50 HP 175/700 RPM
2—Crocker-Wheeler 125-H 50 HP 175/700 RPM
1—West. SK-143 40 HP 500/1500 RPM
2—Reliance 461-T 40 HP 475/1500 RPM
2—Allis-Chalm. 35-70 HP 450/1350 RPM
1—Allis-Chalm. 25 HP 600/1800 RPM
1—Reliance 230-T 20 HP 400/1600 RPM
1—G. E. CD-93 15 HP 500/1500 RPM
1—G. E. CD-103 15 HP 400/1600 RPM
2—West. SK-123 5 HP 300/1200 RPM enclosed

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Re-built Motors and Generators

2—75 HP, 2200 V, **Fairbanks Morse,** 1800 RPM, 3 PH, 60 CY slip ring motor, direct connected to 500 GPM 3 stage 200' head pump.

1—400 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 450 RPM slip ring motor.

3—350 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 600 RPM slip ring.

1—300 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 485 RPM slip ring.

2—250 HP **Westinghouse,** type CS1012, 3 PH, 60 CY, 440 V, 435 RPM sq. cage.

1—210 KVA **General Electric,** 3 PH, 60 CY, 2300 V, 225 RPM generator direct connected to an **Ames** Uniflow engine, with switchboard.

1—300 HP **Westinghouse** syn. 1 PF, 3 PH, 60 CY, 2200 V 600 RPM with direct connected exciter, 3 or 2 bearing.

2—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

2—150 HP **Westinghouse,** type CW, frame 1000, 2 PH, 60 CY, 440 V, 450 RPM slip ring.

2—100 HP **Westinghouse,** type CS, frame 754 C, 3 PH, 60 CY, 440 V, 870 RPM sq. cage.

3—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 1750 RPM sq. cage.

1—150 HP **Westinghouse,** type CS, 3 PH, 60 CY, 440 V, 450 RPM sq. cage.

1—100 HP **Westinghouse,** type CCL, 3 PH, 60 CY, 2200 V, 1750 RPM sq. cage.

1—100 HP **Westinghouse,** type CW, frame 752 C, 3 PH, 60 CY, 440 V, 1150 RPM slip ring.

1—100 HP **Wagner,** type 26V5BP, 3 PH, 60 CY, 440 V, 860 RPM sq. cage

2—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 440 V, 690 RPM slip ring.

1—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 2200 V, 690 RPM slip ring.

1—75 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

1—75 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 720 RPM slip ring, 3 or 2 bearing.

1—75 HP **Fairbanks Morse,** type H, frame 165 C, 3 PH, 60 CY, 550 V, 900 RPM sq. cage.

2—75 HP, **General Electric,** type I, 3 PH, 60 CY, 220 V, 720 RPM sq. cage.

1—75 HP **Lincoln,** type IQ, 2 PH, 60 CY, 440 V, 600 RPM sq. cage.

1—75 HP **Finn-Weiksel (Wagner)** ty. 26VRN, 3 PH, 60 CY, 220 V, 1200 RPM syn.

1—250 HP **Crocker Wheeler,** type CCM, size 151 H, 230 V, 600 RPM, DC

3—100 HP **General Electric,** type CD, frame 123, 230 V, 1200 RPM DC

1—60 HP **General Electric,** type CD, frame 115, 230 V, 850 RPM, DC

1—50 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 565 RPM

1—50 HP **General Electric,** Class 6, Form B, 600 V, DC, 600 RPM

1—60 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 680 RPM

1—60 HP **C&C,** 230 V, DC, 250/1000 RPM

1—75 HP **General Electric,** type CD, frame 176, 550 V, DC, 250/1000 RPM

3—75 HP **Westinghouse,** type SK, frame 150, 230 V, DC, 1100 RPM

1—**Sprague** Dynamometer, type LC, 150 HP, 250 V, 2300/3500 RPM with new Toledo scale, no control panel.

1—100 KW **General Electric,** type DLC, 125 V, DC, 440 V, AC M-G set.

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207 N. Fourth St. Hamilton, Ohio

Est. 1903

3—380 HP **Heine boilers**, 180# pressure.
2—500 HP **Stirling** 180# pressure boilers.
2—511 HP **Union Iron Works boilers**, 200# press., Westg. stokers.
2—600 HP **B&W boilers**, 200# pres., complete plant.
2—200 HP **Erie City Economic boilers**, 150# pressure
3—1200 HP **Stirling boilers**, 200# pressure.
3—315 HP **Lasker Adams boilers**, 200# pressure. Firerite stokers.
2—350 HP **Stirling boilers**, 200# pres., oil burners.
1—200 HP **Brownell locomotive boiler**, 150# pressure, stoker.

3—715 HP **Stirling boilers**, 225# pressure.
2—407 HP **Erie City boilers**, 250# pressure, with stokers.
1—2000 HP **Cochrane metering feed water heater.**
2—625 KVA **General Electric turbines**, surface condensers.
1—1014 **Stirling Boiler**, 275# Pressure **Taylor underfeed Stoker.**
1—2000 KW **Westinghouse condensing turbine**, complete, Jet condenser.
1—1250 KW **G. E. extraction turbine**, complete surface condenser, all auxiliaries.
2—125 KVA **Skinner** (counterflow) **Eng. Gen. sets.**
1—250 KVA **Erie Ball Corliss** engine generator.

1—250 KVA **Skinner uniflow engine.**
1—180 KVA **Ames uniflow engine generator set.**
1—250 KVA **Fairbanks Morse full Diesel engine.**
1—300 KVA **Fairbanks Morse VA full diesel engine generator sets.**
1—1000 KVA **Skinner uniflow eng. gen. set, 3-60-240** volts.
1—375 KVA **Skinner uniflow engine generator set.**
5—180 HP **Fairbanks-Morse** Model 35, Oil Engines, new in 1935.
1—84" x 125' self-supporting **steel stack.**
1—**Cochrane feedwater heater**, 90,000# per hr., 10# pressure.

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General Electric 3,500 KW, 6 phase, 25 cycle, Rotary Converter, #1353004 — Booster type, 240-310 volts DC—18 pole and inter poles, 20,000 amps DC circuit breaker—AC breakers, 3,850 KVA Transformers.

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500—Various Circuit Breakers up to 4,000 amps. including relays; Current and Potential Transformers—Solenoid and Hand Operated.

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2—300 HP, 225# working pressure, Watertube Boilers, Oil Fired, Complete.

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2—450 HP Turbine 3600 R.P.M.

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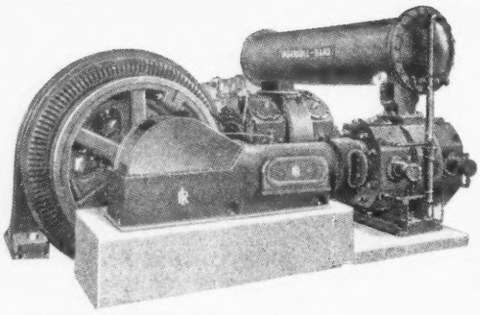
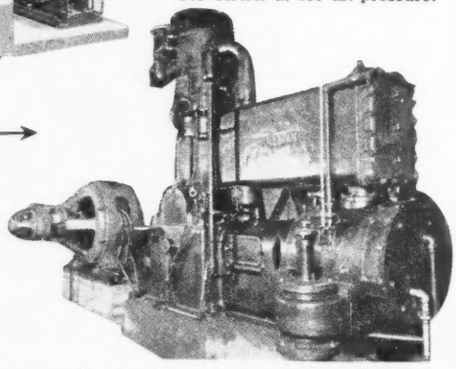


1—Peerless, 9x8, 86 C.F.M. at 100 lb. pressure.
1—Class 11A Pennsylvania, 10"x 4½"x10", 180 C.F.M. at 400 lb. pressure.
1—Type 10-XRB Ingersoll-Rand, 8½" 4½"x10", 240 C.F.M. at 100 lb. pressure.
2—Type 10 "Imperial" Ingersoll-Rand, 12"x7½"x12", 327 C.F.M. at 100 lb. pressure.
1—Type BP4H Bury, 15"x9"x12", 546 C.F.M. at 100 lb. pressure.



1—Class WJ3 Sullivan, 17"x9¾"x12", 788 C.F.M. at 100 lb. pressure.
1—Class HA Gardner Denver, 17"x 10½"x12", 870 C.F.M. at 125 lb. pressure.
1—Type 10-XRE "Imperial" Ingersoll-Rand, 17"x9"x14", 900 C.F.M. at 100 lb. pressure.
1—Type G-CB Chicago, 22"x14"x16", 1055 C.F.M. at 100 lb. pressure.
1—No. 12 Ingersoll-Rand, Imperial Type, 2½"x3", 200 lb. maximum pressure, portable.
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800 HP 520 KW 2300 V. **Busch Sulzer** 6 cyl. 277 rpm **Diesel Generator.** Feb. Delivery.
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4000 KW **Complete Turbo Plant** with Boilers.
150 KW **Ridgway** 4 valve **Eng. Gen.** 3/60/220 V.
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20/25 ton **Link Belt Electric Locomotive Crane.**
35 ton 8 wheel 70" B. **Steam Locomotive Crane.**
5000 HP **Hoppes Feedwater Heater**, 10# Pres.
80 HP **American** 3 drum **Hoist**, 3/60/440 volt.
30 ton **Plymouth** 4'8½" ga. **Gasoline Locomotive.**

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(some complete plants)

2—300 H.P., 180# 3 drum, low head, bent tube, pulverizers. Water walls. Complete plant.
2—400 H.P., 250#, 3 drum, bent tube, side dump stokers.
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1—450 H.P., 250#, bent tube, under feed stoker.
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150 HP. 600 RPM. 3/60/220, General Elec. IM
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100 KVA. 1200 RPM. 3/60/220, General Elec. ATB

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625 CFM. Bury Class CCB 18x10x14 two stage

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100 HP. 1200 RPM. Sterling 4 cyl. dual ignition

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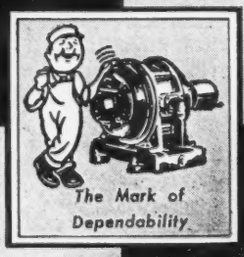

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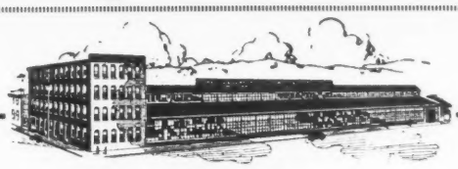

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3—275 HP, 70% P.F., 600 RPM, 3 Ph., 60 Cy., 440 volt, 3 bearing with D.C. Exciters, G.E. Type ATI.

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2200 Volts, 3 PH., 60 Cy.

2—150 HP, 3600 RPM, Allis-Chalmers, type ARW (New).

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2—300 KW Elliott, 250 volts, D.C., 165 RPM, connected to 21x28", 4 valve Automatic Type M Engines.

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1—150 KW, 275 V., 900 rpm, type SK, Westgh. to a 225 HP, 3 ph., 60 cy., 230 V., unity P.F., Westgh. syn. motor with A.C. and D.C. panels.

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1—937 KVA, 750 KW, 3 ph., 60 cy., 2300 V., 3600 rpm, Gen. Elec. complete with C. H. Wheeler surface condenser, pumps, radojet.

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2—200 KW **Westg. Syn. Motor Generator Sets,** 600 V. D.C., Gen., connected to 290 H.P. Synch. motor 3/60/2200 and 900 RPM, with exciters and controls

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1—700 GPM, 200' hd. electric motor driven **Manistee Water Pump,** 3/60/2200.

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300 KW G.E. 250 V. 2300/4000 A.C. 1200 RPM
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200 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM

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HIGH PRESSURE A.S.M.E. & N.B. BOILERS

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25—85 HP, 175 lb. Kewanee
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3—125 HP, 350 lb. Oilwell
2—125 HP, 300 lb. Kewanee

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1—180 H.P. Allis Chalmers Full Diesel 156 KVA. Allis Chalmers Generator with switchboard complete, perfect operating condition.
1—280 H.P. DeLaVergne Full Diesel 240 KVA. G.E. Generator with switchboard complete, perfect operating condition.

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1—125 KVA **Fairbanks Morse** 3 ph. 60 cy. 220/440 volt 900 RPM.
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1—150 Hp. **General Electric** 600 RPM **ATI** as above.
1—125 Hp. 900 RPM **Wagner, Finn-Weischel,** as above. Modern Plate Valve rebuilt guaranteed air compressors.
1—17x10x14 **Bury** Plate Valve 150 Hp. modern unit complete.
1—100 Ft. 2 stage plate valve, **Chicago Pneumatic Tool Co.,** type O.C.B. Low pressure or vacuum units.
1—1200 CFM 15x15x10, 10 to 60#.
1—1000 CFM 20 x 10 **Union,** 5 to 20#.
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1— 746 CFM 17 x 10 **Chicago Pneumatic** 5 to 30#.
1— 600 CFM 15 x 10 **Chicago Pneumatic** 10 to 60#. 75 Small units.
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1000 MOTORS ALL SIZES.

LEA Electrical Equipment Co.
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1—783 h-p Water Tube Boiler
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2—511 h-p Water Tuber Boilers,—complete Plant
2—78"x18" H-R-T Boiler Plants—and Stoker

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For Sale— ELECTRIC MOTORS

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1—75 HP, Allis-Chalmers, 720 rpm, Sq. Cage motor.
2—100 HP, G.E. 900 rpm, MT-356, slip-ring motors.
1—100 HP, Westinghouse, 720 rpm, Type CW, slip-ring motor.
1—150 HP, Gen. Elec., 600 rpm, Type I-M, slip-ring motor.
1—200 HP, Gen. Elec., 720 rpm, Type ATI, synchronous motor.
1—300 HP, Elliott, 580 rpm, Type 32 NX, Sq. cage motor.
1—500 HP, Gen. Elect., 450 rpm, Type I, slip-ring motor.

All 3 Phase, 60 cycles, 220 or 440 volts. Each complete with necessary control. Prompt delivery from our stock.

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1—12x10 Chicago Pneumatic belt driven compressor, 100 lbs.

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1—160 **KW West.** 3/60/480 Belted Exct. Dir. con. Chase left hand 4 val. non-release eng. 17x21.
1—312 **KVA West.** 3/60/2300 v. belt, exct. dir. con. Murray Special Corliss left hand eng. 18x30.

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1—610 c. ft. **I.R.** St. Dr. 100# air, 150# stm.

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2—10 AD 4 pass 210 ft. **Foster Wheeler** Surf. Condensers over Comb. Air, Circulating and Tail pump.

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1—**Snow** 6 mgd C&FW Cr. Com. Opp. Type Cond. 20-40x13¾x36, with waterwork type cond.
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2—50 HP NEW Diehl Type K10 230 V DC 600/1350 rpm Comp'd. interpole drip-proof bare motors in original factory crates.
1—150 HP Westinghouse CW Slip Ring 3-60-440 V—600 rpm bare motor.

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FOR SALE

1—180 H.P. **Allis-Chalmers,** Horiz. 2-Cylinder 16" x 24" Full Diesel Direct Connected to 156.5 Kva. 3/60/2300-Volt Generator.
1—280 H.P. **De La Vergne,** Horiz., 2-Cylinder 20" x 34 Full Diesel Solid Injection, Direct Connected to 240 Kva G-E Generator 3/60/2300 V.

Both have Exciters, and Switch Boards
All Ready for shipment—Kansas City.
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ENGINE GENERATOR SET

300 KW Nordberg Unaflow Engine Generator Set. 230/115 Volts D.C. On Original Foundation Complete. Purchased new in 1924 A-1 Condition.

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750,000 C.M. POWER CABLE

VERY GOOD CONDITION

Water proof
(Suitable for marine uses)
One Piece—843 Ft.
3 phase—with Lug Connections

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G.E. Turbo Generator

500 KW. 240 Volts, 100# Steam Pressure Complete with Exciter, Voltage Regulator and other switchboard instruments.

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QUALITY ELECTRICAL EQUIPMENT

6—GE KT—50 HP—900 RPM—3 ph—60 cyc—220v. with CR 1034 compensators.
We have large stock all kinds equipment. Send us your inquiries.

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CANTON OHIO

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Answer M. J. HUNT'S SONS IN PHILLY

A.S.M.E. HORIZONTAL SELF-CONTAINED	Lbs. Pressure
210 H.P. Stanwood	125
210 H.P. Oil City	100
165 H.P. Ames "Empire"	125
160 H.P. Oil City	100
140 H.P. Locomotive	125
100 H.P. Titusville	125
100 H.P. Erie City Economic	100
100 H.P. Scotch Marine	125
50 H.P. Ames	100

WATER-TUBE TYPE

380 H.P. Heine ..... 180 lb. pressure
200 H.P. Heine ..... 180 lb. pressure

We also have in stock horizontal return tubular, heating, crane and vertical types of boilers, completely rebuilt. Our stock is constantly changing, so it will pay you to contact us when in the market for reliable power equipment.

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Don't HUNT—Call . . . M. J. HUNT'S SONS

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2—**500 KW General Electric,** late pedestal type, **SYNCHRONOUS ROTARY CONVERTERS,** form P, 250 volt DC, switchboards and switchgear, 2300 volt transformer.

1—**200 KW General Electric SYNCHRONOUS ROTARY CONVERTER,** 250 volt DC, 2300 volt transformer, switchboards and switchgear.

WANTED FOR RESALE

200, 300 and 500 KW Motor Generator Sets and Rotary Converters.

Coal Mine Equipment Sales Co.
306-307 BEASLEY BUILDING
Terre Haute — Indiana

G.E. SLIPRING MOTORS, 60 Cy., 3 Ph.

Quan.	HP	Volt	Speed	Type	Frame
6	300	550	600	HITC	5017A
6	200	550	600	HITC	5015A
10	75	550	600	HITC	5013A

G.E. SQUIRREL CAGE MTRS, 60 Cy., 3 Ph.

3	100	2200	600	I	15A
1	40	2200	1800	KT	527
4	30	2200	1200	KT	332
3	25	2200	1200	KT	326
10	15	550	1200	KT	302

G.E. OIL CIRCUIT BREAKERS

17—60 Amp., 2200 Volt, FK 20
1—100 Amp. 23000 Volt automatic reclosing equipment
1—20 KW. G.E. 60 Volt Generator, 30 HP 440 volt motor
17—500 KVA transformers, G.E. 23000/600 Volt, 3 Phase, 60 Cycle

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SPEED REDUCERS REEVES DRIVES

All Sizes — Types — Makes

SAVE 60% OF NEW COSTS

All Materials Overhauled, Guaranteed

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1175'—Ingersoll-Rand, Type XCB, Air Compressor, Ser. No. 62235-6, 50# pressure, short belt drive with 100 HP G.E. A.C. Motor, starting equipment.
870'—Ingersoll-Rand, Type XRE, Air Compressor, Ser. No. 95040, 125# pressure, direct connected to G.E. Synchronous Motor, type TSF, 150 HP, A.C., starting equipment.
750'—Gardner-Denver Air Compressor, 125# working pressure, short belt drive with idler.
165'—Worthington Air Compressor, Ser. No. L-38537, 3 stage, 1200# working pressure, steam driven.

DENNY & CLARK
910 No. Marshfield Ave., Chicago, Illinois

FOR SALE

STEAM TURBO GENERATORS

2—**CURTIS STEAM TURBO GENERATORS, 35 K.W. 3600 SPEED, 100# PRESSURE,** Connected to: G.E. Generator 120 volts.

1—**CURTIS STEAM TURBO GENERATOR, 125 K.W. 2400 SPEED, 100# PRESSURE,** Connected to G.E. Generator 120 volts.

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Ready for Delivery!

1—**1500 AMP. BALL BEARING PLATER,** 6 volt, double commutator with base, coupling, exciter, shunt & panelboard. **Priced to Sell.**
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1—3 K.V.A. **LOUIS ALLIS BALL BEARING Converter,** DC 230 volts to AC 110 volts 3 phase.
MOTORS—New **General Electric** and **Wagner**—3-phase, 60 cycle 220-440 volt.

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WE SELL — PURCHASE — RENT

Power & Dist. Transf. from one to 5000 KVA. Any Volt or Frequency.

Motors, Generators, Turbines, Centrifugal Pumps, etc.

A.C. & D.C. Elec'l Meters, Potential & Current Transf. All Makes. Scales Calibrated to your requirements.

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1—75 H.P. Reliance D. C. 220 V 900 RPM
1—75 H.P. C. D. D.C. 115 V 1200 RPM
1—60 H.P. E. D. 230 V 525-1050 RPM
3—35 H.P. L. C. 220 V 650-1300 RPM

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At Central Wharf

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60 H.P. F & M 3/60/2300—F & M GEN.
80 H.P. ATLAS—BELTED
100 H.P. FULTON—BELTED
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2—300 H.P. F & M 3/60/2300 F & M GEN.
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80 H.P. BALL 53 K.W. 125/250 VOLT 3 WIRE WESTINGHOUSE GENERATOR
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125 H.P. SKINNER CENTER CRANK
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Complete Repair and Maintenance Facilities For All Reciprocating Machinery

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125 KW, G. E. 125 v. D.C. M.G. Set with 3 ph. 60 cy. 1200 RPM, squirrel cage G. E. M. D.
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35 KW, Westinghouse, M.G. Set 125 volt D.C. generator driven by 54 H.P. 220/440 volt 3 phase, 60 cycle, 1200 RPM CS motor.
300 amp. 40/0 volt Lincoln Welder with 10 HP 220 volt, D.C. motor.

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BOUGHT—SOLD

One of the Largest Used Stocks in the East
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Main 4-3804-5

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FOR SALE

1—20 x 20 Skinner Automatic Engine 190-230 R.P.M. 125# 0-10# B.P.
1—375 K.V.A. 225 R.P.M. General Electric Type A.T.B. 3 ph. 60 cyc. 440 volt Generator
1—400 H.P. 720 R.P.M. 3 ph, 60 cyc., 440 volt Synchronous Motor with base for direct connected D.C. Generator
3—5 H.P. 1200 R.P.M. General Electric Slip Ring Motors
1—25 H.P. 900 R.P.M. Westinghouse Ind. Motor
1—30 H.P. 900 R.P.M. General Electric Ind. Motor
1—40 H.P. 1800 R.P.M. General Electric Ind. Motor
6—50 H.P. 900 R.P.M. General Electric Ind. Motors
1—75 H.P. 900 R.P.M. General Electric Ind. Motor
All 3 ph. 60 cycle 440 volt
1—Magnetic Clutch, Cutler-Hammer Type H 44" 300 H.P. @ 240 R.P.M. 110 Volt D.C.

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NEWTON FALLS, NEW YORK

FOR SALE

BOILERS

2—400 H.P. Heine Cross drum water tube boilers, 3½"x16' tubes, delivering saturated steam at 16= gauge; complete with modern brick settings, Liptak arch, soot blowers.

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3—Illinois chain-grate stokers, 7' 11"x10' 0" grate surface, natural draft.

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1—Steel Stack 66" in diameter, 150' high.

Also incidental power plant items, miscellaneous electric equipment, 4" pipe-threading machine, duplex and triplex steam pumps, etc.

The above items displaced on June 15, 1941, on account of changes in power supply. Are available for inspection at our plant at Paris, Illinois.

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PARIS, ILLINOIS

AVAILABLE IMMEDIATELY

One—410 h.p. **Riley "Ring Flow" 4 Drum Boiler**, A.S.M.E. 160#, full water cooled furnace for P.C., oil or gas firing, six years old, A-1 condition.
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One—**Riley Atrita No. 3 pulverizer** with A.C. motor drive and 4 speed F.D. fan.

Full specifications upon request.

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Cincinnati, Ohio

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FOUR COCHRANE DISCHARGERS

Model A2, S. O. 5284-34. Serial 415, pressure 200 lbs., Max. Temp. 388. Pilot Valve orifice 129 to 200 lbs. range.

Excellent condition

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5—1,000 GPM Centrifugal Fire Pumps with AC motors either 220-440-2200 v.

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1—35 H.P. **Reeves Gas Engine.**
1—16 KW D.C. **Generator, Burke**, 300 RPM. 64 amp., 115/230 volts.
1—15 H.P. D.C. **Motor, G.E.** Type RC, FORM A30, 1150 RPM, 230 volts.

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Newark, Ohio

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1—Air Compressor, Worthington Pump & Machine, steam driven, size 12 x 30 x 15 x 14, 1330 cu.ft. per minute, 235 R.P.M., 50# maximum pressure, 120# steam pressure, #L26581.
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THE NIVISON-WEISKOPF CO.
CINCINNATI, OHIO

Condensing Turbine Unit

375 KVA G. E., 4 Stage, Form B, 200 lb. steam, 240 Volts, 3 phase, 60 cycle, 3600 RPM, equipped with S & K multi-jet condenser, without exciter, with 1200-amp. Condit oil breaker, with two Goulds condenser pumps and common base, but without motor.

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One Crane Elevator Company steam hoisting engine complete with drum for seven-story building. Allowable load about 2,000 lbs.

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TURBO-GENERATOR UNIT

1—300 K. W. West. Cond. turbo-generator unit, 160#, 2 phase, 60 cycles, 2400 volts, geared, (jet condenser)—valves and swbd panel.

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Penn Yan, N. Y.

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1000 gallons per minute against 100# pressure direct connected to 100 H.P. 3 phase 60 cycle 220 volt slip ring type motor.

New condition operated for test purposes only.

Price reasonable, immediate shipment.

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MENTOR, OHIO.

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York 10 ton Ammonia compressor complete with 25 HP 440 v Motor and all accessories. For immediate delivery.

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Glen Gardner, N. J.

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2 HRT Boilers

Designed for 150 lb. pressure.

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1—150 h.p., 12 yrs. old.

Equipped with Type "E" stokers.

Reasonably priced for immediate delivery.

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DEFIANCE, OHIO

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If you don't see the equipment advertised that you want, ask for it—ask the advertisers—or we will gladly ask them for you. Departmental Staff — POWER.

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Power Plants, Sub-Stations, Transmission Lines and Construction

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M.E. GRADUATES not over 40 for design and assembly layout of boilers and accessory equipment. Knowledge of descriptive geometry and thermodynamic calculations very helpful. Location, Middle West and East. Applications must include full resume of schooling, firms worked for and details of experience. P-146, Power, 330 W. 42nd St., New York, N. Y.

GRADUATE MECHANICAL ENGINEERS preferably under 40 with practical experience in boiler-room operation and knowledge of combustion problems. No applications considered unless accompanied with complete history of applicant's background and experience. P-147, Power, 330 W. 42nd St., New York, N. Y.

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POSITIONS WANTED

(See also "Selling Opportunities Wanted")

EXPERIENCED ENGINEER, licensed, 47, over 20 years practice in piping, in design, installation and supervision of high pressure boiler and power plants up to 5000 KW, experienced in all water treatment questions with good electrical and structural knowledge, seeks position with consulting firm, contractor or manufacturer. Now employed desires change. PW-218, Power, 330 W. 42nd St., New York, N. Y.

POWER-PLANT ENGINEER; age 39; married, experience, 2 years machinist, 15 years marine engineer and 7 years stationary engineer operating oil, stoker- and pulverized-coal fired, high-pressure boilers, steam turbines and engines and associated electrical equipment. Holds marine chief-engineer's license and first-class stationary engineer's license in New Jersey. Go anywhere, available January 1, 1942, industrial plant preferred. PW-220, Power, 330 W. 42nd St., New York, N. Y.

Used Power Equipment For Sale

See pages 281 to 306

A Classified Directory of used power equipment offered by advertisers appears on page 281

PRICE & COMPANY

CONSULTING ELECTRICAL AND MECHANICAL ENGINEERS

Technical Advisers to the Purchasers of Used Steam and Electrical Equipment

Inspection Redesign Reports
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POSITIONS WANTED

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MECHANICAL ENGINEER — Broad experience in road service work and trouble shooting with major boiler, control and combustion instrument companies. At present employed but will consider a job in the south or middle west involving combined sales and service. PW-223, Power, 330 W. 42nd St., New York, N. Y.

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OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITIES WANTED

AVAILABLE TO MACHINERY Manufacturer, Sales Executive—experience covers the sale and distribution of machinery to industrial plants, mines, railroads, contractors, and various departments of the federal government; also the merchandising of mechanical appliances through mill supply houses and jobbers. Age 43. Excellent record and references. Reply SA-215 Power, 330 W. 42nd St., New York, N. Y.

EXTENDED APPLICATION Chicago and Middle West territory, in sales of Steam Power Plant Equipment. Must have Salary or Drawing account. SA-219, Power, 520 N. Michigan Ave., Chicago, Ill.

AN ESTABLISHED ENGINEERING sales and service organization now selling leading industrials is interested in an account for New York Metropolitan area, Northern New Jersey, Southern Connecticut. Write RA-221, Power, 330 W. 42nd St., New York, N. Y.

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for well known line of reciprocating and centrifugal pumps and air compressors. Must be thoroughly familiar with general industrial trade in Metropolitan New York area.

Give detailed qualifications, type and amount of remuneration expected.

Permanent position with good future. Applications treated in strict confidence.

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330 West 42nd Street, New York City

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—"increased load, desired voltage at all load demands, lower operating cost" all due to voltage regulators furnished by you having solved our former troubles"
- - - - - - - - - (name upon request)

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Liberal allowance on your old regulator.

Electrical Instrument Exchange
411 N. Ashland Ave. CHICAGO, ILL.

WANTED

WANTED TO BUY

TURBO-GENERATOR

One (1) Turbo-generator, approximately 1500 Kw., 2300 V., 3 Ph., 60 C., 275 lbs. steam pressure, 700 degrees heat, with surface condenser.

CALDWELL ENGINEERING CO.
Jacksonville, Illinois.

WANTED

FOUR NEW OR USED BOILERS

Minimum of 400 H. P. each. State age, condition and approved operating pressure including price loaded on cars.

GULF DISTILLING CORP.
P. O. Box 86 GRETNA, LA.

WANTED

1—250 to 300 K.W. **Natural Gas Engine Driven Generator** 3/60/2300, Complete
1—450 to 500 H.P. **Natural Gas Engine**

W 224 Power
68 Post St., San Francisco, Cal.

Additional Equipment Wanted

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MASONEILAN CONTROLS
FOR
POWER GENERATION AND SERVICES

- EXHAUST STEAM PRESSURE MAKE-UP CONTROLS
- AIR PRESSURE REDUCING VALVES
- BOILER FEEDWATER CONTROLS
- BOILER PRESSURE CONTROLS
- CONDENSATE LEVEL CONTROLS
- CONTINUOUS BLOWDOWN VALVES
- DAMPER CONTROLS
- DESUPERHEATER STATION CONTROLS
- DIAL THERMOMETERS
- EVAPORATOR FEED CONTROLS
- FUEL OIL PRESSURE CONTROLS
- FUEL OIL TEMPERATURE CONTROLS
- PUMP GOVERNORS
- RECORDING THERMOMETERS
- STEAM FLOW METERS
- STEAM PRESSURE RECORDERS
- STEAM PRESSURE REDUCING VALVES
- STRAINERS
- TANK LEVEL INDICATORS AND CONTROLS
- TURBINE BLEEDER MAKE-UP CONTROLS
- WATER PRESSURE REDUCING VALVES

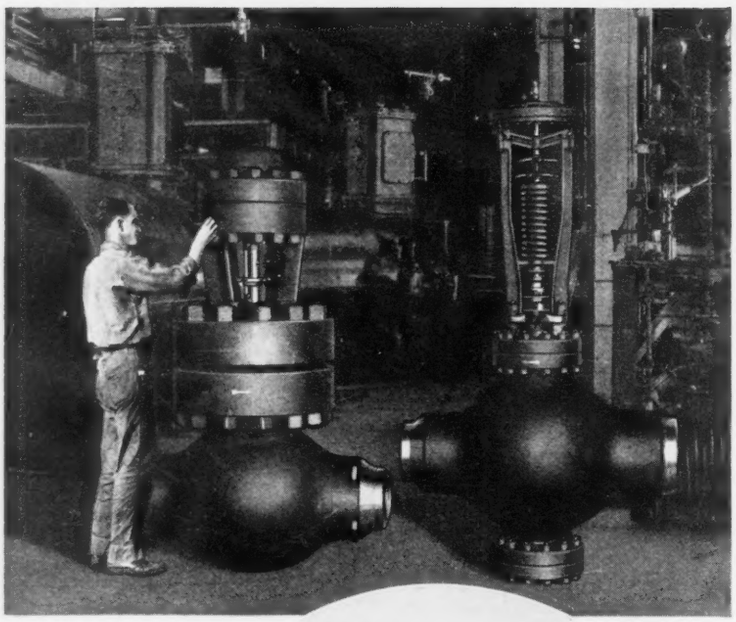
MASONEILAN

MASON-NEILAN REGULATOR CO.
1186 ADAMS STREET, BOSTON, MASS.

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH TULSA TOLEDO
CHICAGO ATLANTA ST. LOUIS HOUSTON LOS ANGELES SAN FRANCISCO
MASON REGULATOR CO. OF CANADA, LTD., MONTREAL, CANADA

Swartwout Controls help you keep profitable power service flowing

with Safety Efficiency and Economy

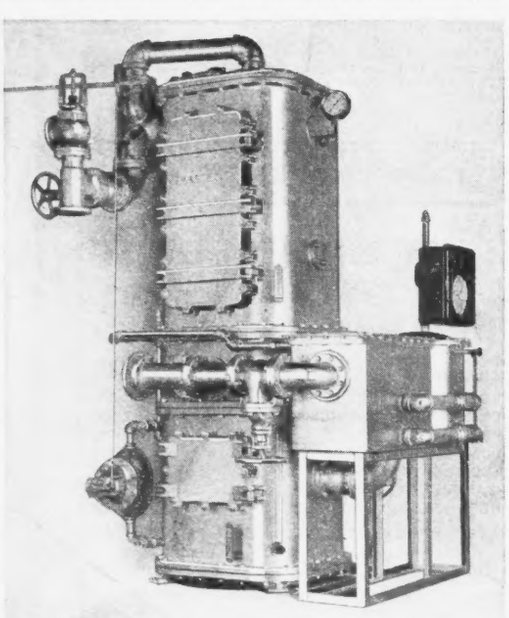


SPECIAL 2500 LB. *standard quick opening bypass valve and high pressure reducing valve.*

IN CIRCLE: *Feed water regulation controls for 950 lb. pressure boiler — load fluctuating from 45,000 lbs. to 400,000 lbs. per hour.* **LEFT:** *Venturi Desuperheater and Atomizer.* **RIGHT:** *Swartwout Metering-Deaerating Heater built to rigid specifications, meets U. S. N. performance tests.*

KEEPING your power supply constant this next year means more than money to your Company; it means prestige, and satisfaction in knowing you've held up your end in the enormous job we're all doing. • Swartwout Equipment is serving steadily and safely in thousands of power plants — is available to you for more efficient control. Here is an unusual team of valves (left) designed by Swartwout — the single seated quick opening valve is located ahead of the spring loaded valve which reduces an initial pressure of 1850 lbs. to a final 400 lbs. • Swartwout has developed feed water regulation for a broad range of applications. The equipment example shows pilot-actuated feed water regulator with manual auxiliary control. • The combination Venturi Desuperheater and Atomizer has a capacity of from zero to 400,000 lbs. of steam per hour. • For assistance in solving problems of Feed Water Heating; Excess Pressure Regulation; Constant, Variable or Differential Pressure Control . . . make it a point to check with Swartwout.

The Swartwout Co., 18501 Euclid Ave., Cleveland, O.



Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•